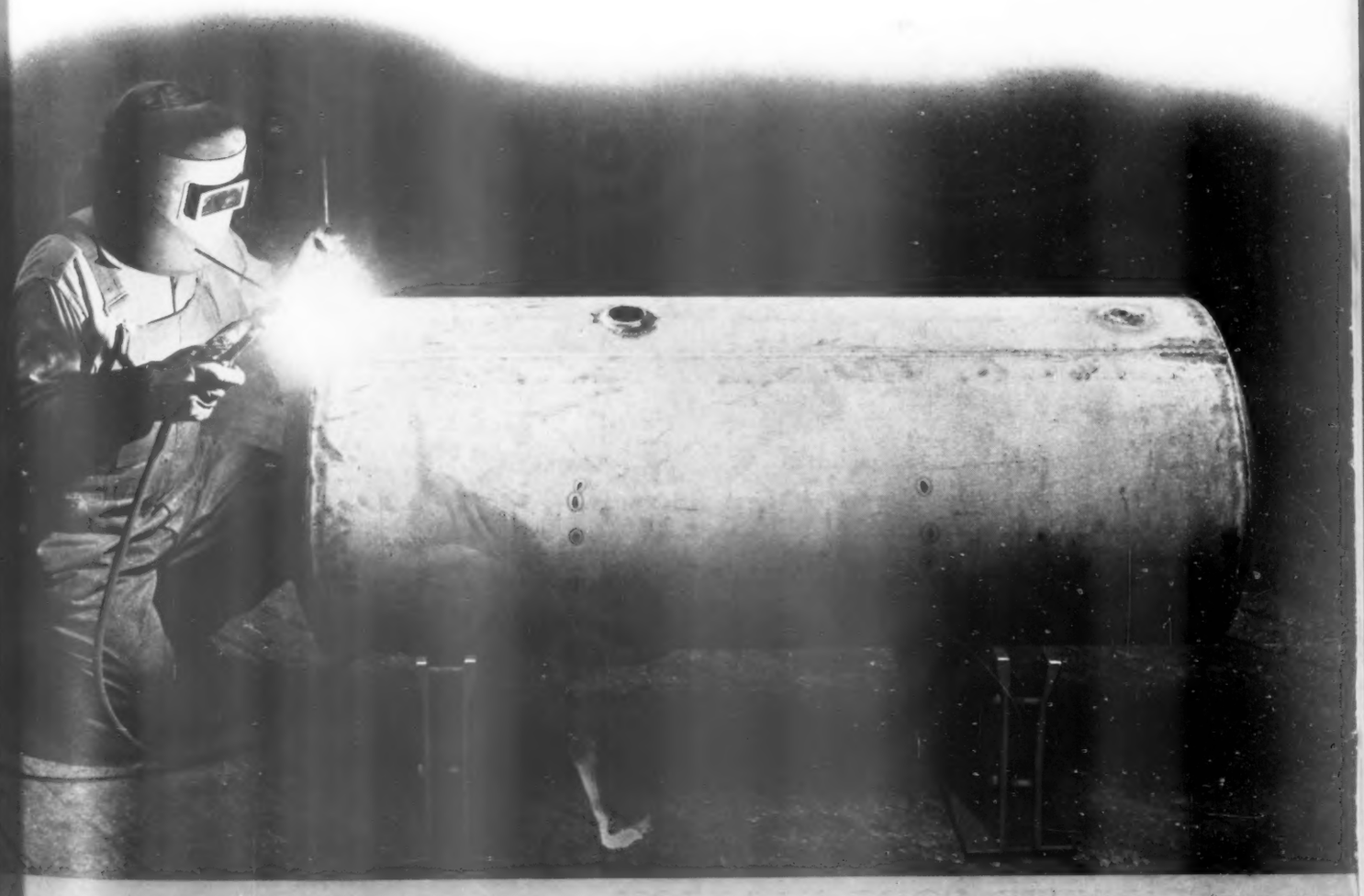
The Welding Engineer

Reg. U. S. Pat. Office

ume XXI April, 1936 Number 4

WELDING head onto copper-alloy tank, using carbon arc with filler rod.

(See Page 28)



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THE WELDING ENGINEER

Vol. 21, No. 4 APRIL, 1936

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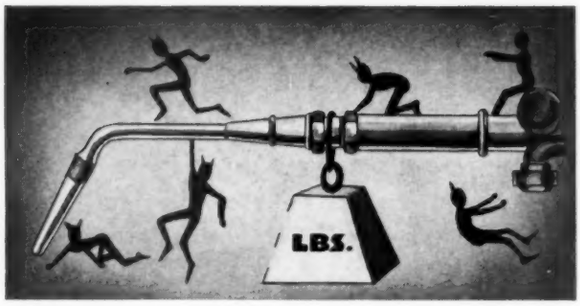

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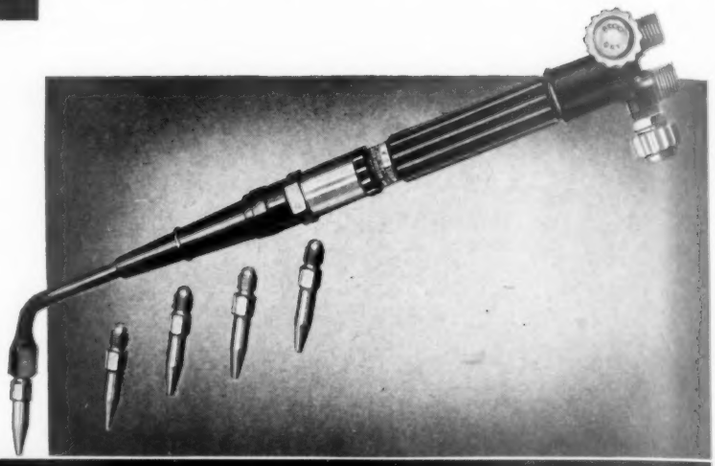

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PIONEERS IN EQUIPMENT FOR USING AND CONTROLLING HIGH-PRESSURE GASES

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EDITORIAL

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High-Tensile Steels in Rigid Design

● A first principle of structural design is that when a member is subjected to a bending moment, deflection occurs. In some structures, punch-press bases, etc., the size and shape of the members must be chosen to hold the deflection within certain limits. Hence, the members may be much larger than strength demands.

High-strength steels are beginning to play a big part in structural design. But when their use is considered for certain members, one must face the stark fact that the modulus of elasticity of steel, regardless of the shape of the member or the alloying elements added, still stays at 28,000,000. Therefore, the designer is apt to see no value in using high-strength steels in those members and plates where considerations of rigidity specify a greater section than strength demands.

The designer, in solving problems of rigidity, is inclined to think in terms of standard shapes, without regard to the possibilities in the use of special shapes made by cutting or by forming. Where any degree of ingenuity is brought to play, it is almost always in the direction of combining plates and structural shapes. Such constructions are satisfactory to some degree, but often they show a lack of consideration or of understanding of the principles of rigidity.

How to make designers more conscious of the importance of combining light weight with rigidity is a question deserving much attention on the part of manufacturers of finished steel and welding engineers (since welding simplifies some aspects of the problem of rigid design). A concerted effort leading to a fuller investigation and development of the theory of rigid design, might be of help.

If a sorry lack of such information exists in the application of mild steel, think how much more it is needed when high-strength alloys are considered!

An excellent example of what serious thought along this line can do is found in the use of thin, high-strength stainless sheets in the building of transportation equipment. Since spot welding is used in the assembly of the sections of these constructions, the problems involved in the design of these sections are more complex than where arc or gas welding is employed, and the range of possibilities in design is necessarily limited, owing to the fact that in resistance spot welding one must be able to get at the "spot" from both sides of the overlapped sheets.

In applying the principles of rigid design to thin gauges of alloy steels, ribs pressed into the sheets may provide enough rigidity in some instances, and in other cases it may be necessary to weld to the sheets certain pressed shapes made from similar sheet to give a high section modulus.

But, knowing these things, the designer still has before him the problem of selecting the correct shape of the final section and determining the correct location and spacing of the ribs or stiffener shapes. The material available in handbooks won't be of much help to him.

Designing for rigidity is an art in itself, and requires a perception that can be obtained only by the understanding and application of certain basic principles with which designers generally are familiar. But until these principles have been further worked out, the designer will have to depend largely on his own ingenuity and resourcefulness in utilizing the properties of materials to the utmost.

The Owen

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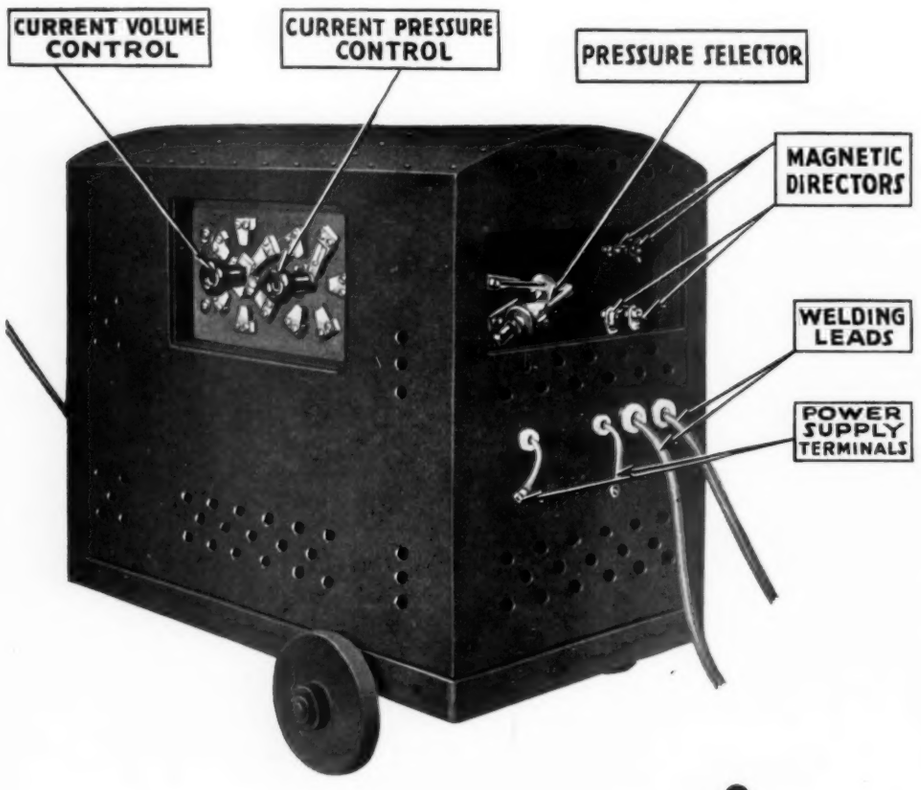
OXIDATION WITHIN THE ARC*

"Oxidation of the metal passing thru a long arc is injurious to the efficiency of the weld. Metal at high t perature, particularly in the very finely divided state in which it passes thru the arc, has a very great affinity for oxyg The arc stream is maintained in an atmosphere of oxygen and nitrogen and oxidation proceeds at a tremendous r and the metal is bound to burn even in spite of its enormous velocity in passing thru the arc. Nitrogen will also absorbed so that the metal as it solidifies on the weld will be permeated with iron oxide as well as inclu nitrogen * * * *

"Two test bars may be built up, one with a long arc and the other with a short arc, and each tested to dest tion in a tension machine. The tensile strength of the bar made up with the long arc will in no way compare with by the short arc."

*From the *Welding Encyclopedia*. Written by E. Bauer.

Welding with The **OWEN** Welder permits the deposition of weld metal that is free from oxidization, blow or w holes because the welding can be carried on with the electrode in contact with the metal being welded.



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OWEN ELECTRIC

FAYETTEVILLE, N. C.

The Welding Engineer

VOLUME XXI APRIL, 1936 NUMBER 4

154-Ton High-Pressure Refinery Unit

Welded in 34 Days . . . .

By ERNEST H. PETERS

Superintendent of Welding, Southwest Welding & Manufacturing Corp.

WITH the discovery of oil and its subsequent demand for pipelines, tank storage farms and refineries, the petroleum industry has grown at such an amazing pace that it now holds a position of importance second to none. On the whole Pacific Coast, and particularly in California, with its vast oil-fields and numerous refineries, this has had a major bearing on the steel industry as a whole.

Welding, with its vast flexibility of design coupled with the steel fabricator's ability to keep pace with the demand, has been a deciding factor in its growth.

Competition in the gasoline and oil industry has forced petroleum engineers over into highly specialized refinery equipment operating at high working pressures, and at elevated or at subzero temperatures.

This has taxed the ingenuity of the steel fabricator, not only with regard to the methods of fabrication and welding, but with regard to completing the specified equipment in the limited time allotted by the customer.

The degree of success attained may be judged from the following facts concerning a refinery unit, fabricated in Alhambra, Calif., through Alco Products, Inc. of New York, for service in a California plant of the Shell Oil Co.

The unit, comprising two refinery towers of 72-in. inside diameter and 76-ft. length, and several smaller vessels, was built under the API-ASME Code for Unfired Pressure Vessels.

Largest of Towers Weighs 180,000 Pounds

The largest of the towers, weighing 180,000 lb., was constructed of 2⅛-in. flange-steel plate, designed for a working pressure of 600 lb. per sq. in. at a temperature of 350° F. This is believed to be the heaviest plate construction so far on a refinery tower of this size on the Pacific Coast.

Radiography played a prominent part in the selection of welding equipment and rod.

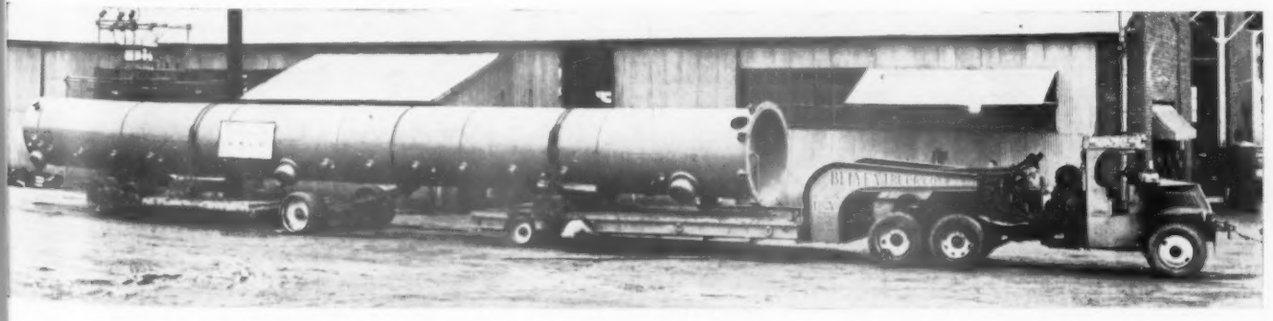
The conventional U-type bevel was used on longitudinal and girth seams, the planed edges forming a U or trough approximately 1 in. wide at the surface and 2 in. in depth, with a ⅛-in. tongue, or seat, at the base for alignment purposes.

Ready for Assembly.
(The towers were built up of welded sections like this one. Walls are 2⅛ in. thick.)

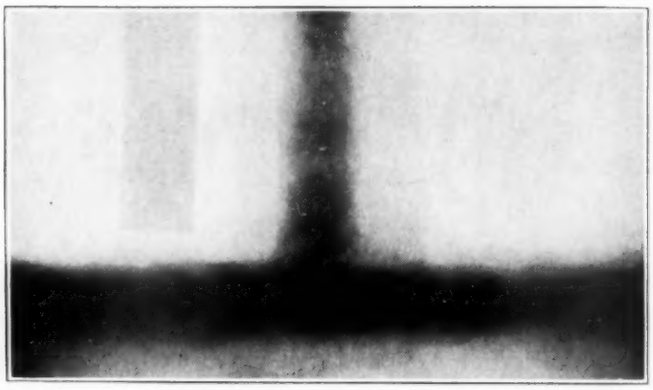
The shell plates, after rolling, were assembled into sections of three, 21 tons in weight, and heavily tack-welded, for ease of preliminary handling.

The shell sections and heads were automatically welded with coils of semi-flexible, shielded-arc welding wire.

After the longitudinal seams were au-



Completed Refinery Tower, 76 Ft. Long, Weighing 90 Tons, Welded in 34 Days.



Junction of the Seams.

(This radiograph shows where the automatic welded longitudinal and girth seams join. Underneath can be seen the hand weld.)

tomatically welded, the sections were rotated for girth-seam welding on rolls driven by a d.c. motor controlled with a speed rheostat by the welding operator. The sections were thus rotated to maintain a surface welding speed of 1½ ft. per minute for each pass deposited. All automatic welds were made with a 1/16-in. reinforcement.

Each seam was then back-chipped inside to clean metal, and welded with a single pass by hand.

Weld Structure Similar to That of Parent Metal

Radiographs of the automatic welds showed a clean, dense structure, similar to the parent metal. The continuous feed of the coiled welding electrode, and consequent uninterrupted arc, was a great factor in eliminating the gas pockets and flux inclusions sometimes encountered in hand welding with standard-length electrodes, where numerous starts and stops are encountered.

Contained within the tower were 40 bubble cap trays, or seal plates, of ⅜-in. plate, 6 ft. in diameter, weighing approximately 16,000 lb., continuously welded to the shell plate, and placed at 18-in. intervals.

The entrance manhole nozzles were fabricated of 3-in. plate, which, upon assembly on the tank with its reinforcing plate, required a champfer 4 in. in depth for hand welding.

These sections, after stress-relieving in a furnace, were assembled into the completed vessel, the girth seams thus welded being locally stress-relieved with a specially constructed portable furnace, at a temperature of 1150° F.

No Leaks, No Deflection Under 967 Lb. Pressure

An applied hydrostatic test of 967 lb. per sq. in. revealed no leaks of any kind, and showed no visible deflection at any point.

A clearer understanding of the benefits obtained by welding, in heavy-plate vessel construction, may be gained by the fact that this unit as a whole, totaling 154 tons, was completed for erection in 34 days.

Construction was under the complete supervision of Benjamin A. Gritzmaker, plant superintendent.

World's Largest Distillery Economizes With Welding

The world's largest distillery, Hiram Walker & Sons of Peoria, Ill., recognizes welding as an important factor in the saving of time and expense, in making repairs and in the building of new rackhouses, one of which has just been completed on the spot where an old one was destroyed by fire.

This new rackhouse is of steel, reinforced with concrete, the sheetmetal roof being tack welded to the roof trusses and purlins. The sheetmetal roof of the high-wine building, which was damaged a few months ago by an explosion while repairs were being made on an alcohol tank, was replaced and also tack welded, as are all the roofs of this distillery.

The company has its own maintenance crew, which is now busy welding the top of the large storage tank that was badly bent by the explosion, although no fittings were damaged. Near this high-wine building is the evaporator plant, where the Robins Conveying Belt Co., of Chicago, has a large crew of men welding clips to support a conveyor system.

Foundations are being laid for two more rackhouses, to be built south of four that have just been completed. Sheetmetal roofing will also be used on these, a considerable amount of welding being involved.

Welding Largely Used in the Building of Towed Craft

More than one-half of the gross tonnage of non-propelled vessels built in the United States in 1935 was constructed in boat yards located on the upper Ohio River, principally in the Pittsburgh district, according to a recent report. Of the 305 pieces with a gross tonnage of 86,495 constructed last year, 142 pieces with a gross tonnage of 54,227 were built in five yards in the Pittsburgh area and one yard at Point Pleasant, W. Va. Practically all this equipment involved welding operations of one kind of another, and in recent months the trend has been unmistakably toward welded instead of riveted construction.

The Dravo Contracting Co., of Pittsburgh, led the field with 15,439 gross tons, represented by 35 pieces. The others were: Midland Barge Co., of Midland, Pa., 40 pieces, 13,220 gross tons; Bethlehem Steel Co., Leetsdale (Pa.) works, 37 pieces, 12,399 gross tons; Marietta Manufacturing Co., Point Pleasant, W. Va., 13 pieces, 4,155 gross tons; American Bridge Co., Pittsburgh, Pa., 10 pieces, 6,609 gross tons; and the Jones & Laughlin Steel Corp., Pittsburgh, 7 pieces, 2,405 gross tons.

Of the 35 pieces built last year by the Dravo Contracting Co., three were of the propelled type, one a twin screw and two of the stern-wheel tow-boat types. On Jan. 1 this concern had under construction 30 pieces with a total gross tonnage of 13,278, of which number five are of the propelled type.

It is said that 26 of the 30 pieces under construction by Dravo will be welded instead of riveted.

Two-Mile Steel Water Pipe Salvaged With Welding

By R. B. HUTCHISON

Arc welding and oxyacetylene cutting were recently used by The Peerless Welding Co., 256 Tenth St., San Francisco, in salvaging and relaying a two-mile-long 36-in. steel pipeline, according to Rudy Steeker, owner of the company.

The pipe had been used as a temporary water line in Alameda County and had been laid on top of the ground. In the work of salvaging, this pipeline was cut into 60-ft. lengths through the original welds at the bell and spigot joints. In these lengths it was hauled to San Francisco to yards used by the company to continue the salvaging work.

First, cutting was done with two oxyacetylene torches in such a manner that the bells were not mutilated, any necessary injury to the pipe being confined to the spigot ends.

Spigot ends were then recut in the yard, using two torches and cutting from inside the pipes, thus assuring a perfectly square cut. In this manner loss of metal was held down to 4 in. for every 60-ft. length.

Each 60-ft. length was then cut with a torch into two 30-ft. lengths and the surfaces of the steel, both inside and out, reconditioned. The old surfaces were scraped clean and new protective coatings applied, with about 6 in. at either end of each section left clean for rewelding.

As sections were finished they were

relaid for the College Hill pipeline in San Francisco. This pipeline was all-welded in place in the ditch. Sections were welded with two beads outside and one inside.

Welding Research Committee to Expand Organization

Plans to expand its organization for the advancement of welding research are announced by the Welding Research Committee of the Engineering Foundation of which Prof. Comfort A. Adams of Harvard University is chairman.

Under the direction of Col. C. F. Jenks, commanding officer of the Watertown, Mass., arsenal, a new industrial subcommittee to coordinate industrial welding research in this country has been formed. Already 60 investigations, guided by a subcommittee on fundamental research, are reported to be under way in universities alone. Many more researches are going forward in industrial and federal laboratories.

Seven divisional committees are being organized to work with the subcommittee headed by Colonel Jenks in studies of special fields. J. H. Critchett, vice-president of the Union Carbide & Carbon Research Laboratory, New York, has been named chairman of a committee on the welding of low-alloy steels. H. C. Jennison, technical manager of The American Brass Co., Waterbury, Conn., will be in charge of a study of copper alloys.

J. C. Hodge, chief metallurgist of The Babcock & Wilcox Co., Barberton, O., will direct investigations in carbon-steel welding. Four other groups, members of which are now being selected, will deal with cast iron, high-alloy steels, aluminum alloys, and nickel alloys.

Announcement was also made of the formation of three functional subcommittees of the industrial committee. Prof. M. F. Sayre of the department of applied mechanics, Union College, has been named chairman of a methods of testing committee; W. D. Halsey, assistant chief engineer, boiler division, Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn., of a committee on the analysis of weld failures; E. Chapman, vice-president of Lukenweld, Inc., Coatesville, Pa., of a committee on weld stresses and their causes and effects.

A subcommittee on literature, of which Mr. Critchett is chairman, is at work on a critical digest of the world's welding literature, which it is planned to publish in the interests of American industry. The subcommittee on fundamental research, with H. M. Hobart, consulting engineer of the General Electric Co., as chairman, is fostering welding research in universities.

"Today welding is the most important and most widely used method in industry, and in nearly all of its applications notable savings are effected by superior quality of product," Prof. Adams said in a statement explaining the project, which is sponsored jointly by the American Welding Society and the American Institute of Electrical Engineers.

"However, the welding problem is so complicated and the temptation to effect economies is so great that the welding of structures has sometimes been undertaken without a thorough knowledge of the problems involved.

"Most of the literature of importance is of very recent date, scattered throughout a wide range of publications, and in many languages, with the result that most of it is not available to those actively responsible for the planning and conduct of important welding operations.

"It is the intent of the Committee on Industrial Research, under the chairmanship of Colonel Jenks, to make a thorough canvass of the investigations under way, contemplated, or needed by industry without interfering in any way with investigations of a confidential nature.

"The universities will cooperate by conducting worthwhile investigations, other than the 60 already in progress, as may be needed by industry, although specific assignments may, in many cases, be made to industrial and governmental laboratories.

"Welding and its related methods for cutting metals are undergoing astonishing developments. The variety and flexibility of their applications make them available for use in constructing bridges, frames of buildings, ships, pipelines, boilers and other pressure vessels, machines, and many other things, down to small utensils and parts of apparatus, and also for repairing and salvaging."

William Spraragen of New York, secretary of the main Welding Research Committee, estimated that not more than 25% of the possibilities of welding have been fully explored. Welding and related metal-cutting methods can be very useful in repairing the damage done by the recent floods, he pointed out.

"Gradually the application of welding has been extended to all metals and their alloys, and from thin tubing for aircraft structures to heavy vessels 5 in. or more in thickness, designed to withstand severe service conditions," Mr. Spraragen explained. "Complex problems have resulted, involving the necessity for cooperative action.

"Welding has made continual and rapid progress in the shipbuilding field. Welded barges are rapidly becoming the standard method of production. There are in existence a number of all-welded ships of the smaller size that have had continuous service for the past 15 years. Naval treaties have forced all the leading nations of the world to make the maximum use of welding in naval-vessel construction in order to save weight.

"A new era is now well under way in the steel and metal industries, due primarily to the development of high-strength material, which results in lighter-weight construction, improved quality, and economies in cost. Welding and cutting have proved important tools in obtaining maximum advantage from this light-weight construction.

"The first applications will of necessity be in places where savings will result, but gradually the use of these superior materials will creep into every form of construction. Engineers and the industries must of necessity keep abreast of the latest developments, and as the reliability of these products is demonstrated, their use will increase."

Germany, according to engineers, was quick to recognize the advantage of welding, and by substituting this method for the riveting of plates, has effected large economies in the upbuilding of her navy.

Members of the main Welding Research Committee, in addition to those already mentioned, are: F. T. Llewellyn, research engineer of the United States Steel Corp.; John J. Crowe, engineer-in-charge of apparatus research and development department of Air Reduction Co.; and D. S. Jacobus, advisory engineer of The Babcock & Wilcox Co.

Stainless Steel Trailers Made by Budd Mfg. Co.

Construction of standardized light-weight, stainless-steel semi-trailers, built on the principle of the *Zephyr* and *Flying Yankee* trains, has been begun by the Edward G. Budd Manufacturing Co., Philadelphia. The first unit has been delivered to the Victor Lynn Lines, of Milford, Del., and eight more are under way for other purchasers.

The stainless-steel semi-trailer, like the light-weight trains, is built with the structural members being fabricated by the "shot-weld" process into an integral part of the body. By the use of this light-weight metal and through this process of construction, the weight of a standard semi-trailer 24 ft. long and with approximately 1,050 cu. ft. is only 5,200 lb., yet it is fully as strong as ordinary trailers of the same size weighing from 8,300 to 8,500 lb.

The body is so designed as to be readily converted into a fully insulated and refrigerated unit with a total weight of 7,500 lb.

Through the saving in weight of the semi-trailer itself, the pay load can be increased from a ton to a ton-and-a-half. On the basis of a dollar per pound per year for every pound saved, engineers of the Budd company point out that the over-the-road operator can save more than $2,000 a year in operating costs.

WELDED-BARGE Performance SPURS BUILDING of More CRAFT . . .

By HENRY W. YOUNG

FOUR welded barges for river transportation in the Pacific Northwest have now been in service for a year and have proved so satisfactory that four other barges of identical construction to the former were recently constructed, and were launched in the period between Oct. 24th and Dec. 10th.

These barges were built by the Commercial Iron Works of Portland, Ore., being fabricated by them at their works and assembled by them in the plant of the Willamette Iron Works of the same city, located on the bank of the Willamette River. The purchaser of the barges was the Crown-Willamette Paper Co., and they are being used for the transportation of hogged fuel and sulphur.

Tack Welding Bulkhead Partition.
(The upright angles have been welded to the upper and lower transverse and longitudinal members.)

Barges Have Broad Decks and Capacity of 650 Tons

The barges are 135 ft. in length, with a 35-ft. beam, and the depth of the hull is 10 ft. They draw only 18 in., light, and will carry about 650 tons each. The hull of each barge is built in four watertight bulkhead compartments, with watertight deck. No cargo is carried in the hull, which is for buoyancy only. Cargo is carried on the deck, which is surrounded by siding of timber fastened to vertical steel columns welded to the barge frame.

The frame is built principally of ½x4½-in. flat steel bars. Those arranged transversely to the barge are welded to six longitudinals the full length of the hull, three on the bottom and three under the deck. The transverse members are also welded to similar flat bar members corresponding to what would be the ribs of an ordinary vessel.

At the junction of every transverse member with the longitudinal, an angle-iron upright is welded top and bottom, thus stiffening the deck-supporting transverse and longitudinal members. Further stiffening of the whole hull is secured by the three sheet-steel bulkhead walls extending clear across and from bottom to deck.

Onto this frame are welded the bottom and side sheets as well as those of the deck, making a watertight hull, practically all of which is welded. The bottom and side plates are of ¼-in. and the deck plates of 3/16-in. steel, these plates being 5x20 ft., for the largest, and ranging down from that to smaller sizes determined by the shape of the hull. Altogether, there was approximately 15,650 ft. of weld in each barge. In the four barges built last fall, 15,550 lb. of 3/16-in. electrodes were used, almost all of the shielded-arc type.

Welding the Deck.
(Relation of longitudinal, transverse and vertical members of the frame is clearly shown.)

Uprights Welded Along Edges and Also Plug-Welded

The angle-iron uprights are welded to the longitudinal and transverse members not only along their edges but also through the holes made for the holding bolts. For transverse stiffening, a V-shaped plate braces the angle against the top and bottom transverse members.

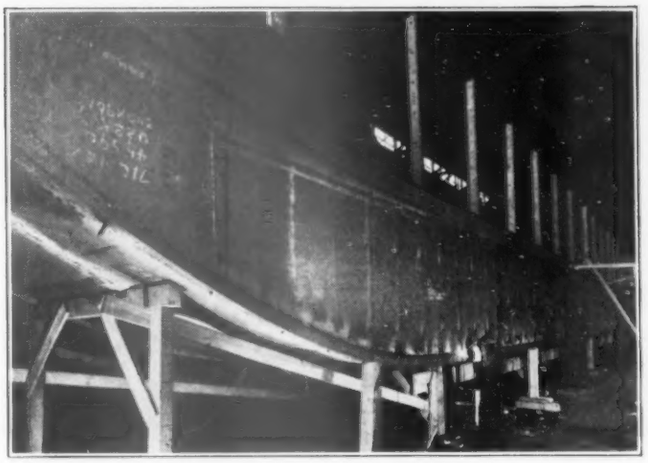
In the case of the bulkheads, the plates are welded on both sides with intermittent welds, consisting of 4-in. welds, staggered. This provides adequate strength but without being so completely rigid against stresses as would a continuous weld on both sides. The side plates have continuous welds, inside and out. Also, the vertical side members of

the frame—the "ribs"—are attached to the side plates by step welding.

Ranged completely around the barge are 10-in. channel-iron uprights, to which the timber siding is fastened.

The deck plates are held in place while welding by means of angle straps bolted to the transverse members and to the deck plates. After they have served this purpose, these straps are removed and the bolt holes welded up.

All the bottom, side and deck plates are joggled in a press at the fabricating plant. When the plates are laid together with the joggles overlapping, and the weld completed, the entire hull presents a smooth outer surface. The mooring cleats on the deck are also welded in place.



Side View of Barge.

(Heat marks of step welding clearly visible on plates at bottom. Note 10-in. channel columns supporting deck siding.)

Warping Avoided by Spacing Out Welding Stations

The welders on the deck plating work at considerable distances from one another. This is necessary to eliminate the excessive expansion and contraction that would take place with too much concentration of heat, with resultant warping or creeping of the deck. As it was, the creep was only about ½ in. Welding was started at the outside, and converged upon a point near the middle. In that way, the contraction stresses on cooling were made to nullify one another to some extent.

At first bare rod was used in overhead welding, because certain welders had not had sufficient experience in using the faster rod on overhead work. With a little training, however, they soon got the "hang" of using the fast rod, and it was employed there as elsewhere.

G. B. Wallace, welding foreman on the last four barges, says of this part of the operation: "When using the fast rod overhead, the tendency of the inexperienced welders was to let too much heat in. They would have the machine set to deliver too high an amperage. What was required at the weld was a 45° fillet, whereas their tendency was to make a rolled bead. By setting the machine right and giving a moderate amount of instruction as to the manipulation of the rod, we soon had them all using the faster rod underneath as readily and satisfactorily as on the sides and deck."

11 Arc Welders Work in Three Shifts of 8 Hours Each

On this last four-barge job, two barges were worked at a time, and as many as 11 arc-welding machines were used at once. All of these were 300-ampere machines, part owned by the fabricator and part rented from J. E. Haseltine & Co., of Portland. Three shifts of eight hours each were employed. The old adage that "practice makes perfect" was exemplified here: The last barge was welded in 15 days, from keel to launching.

In the fabrication of the barges and their welding, there was close co-operation between the Commercial Iron Works' management and the electrical and mechanical departments of the General Electric Co. and J. E. Haseltine & Co., of Portland.

Overhead Welding at the Prow.

(For overhead work some of the welders had to receive special training.)

Bradley College (Peoria) Has Full Classes in Welding

Popular demand for instruction in oxyacetylene and electric welding, mostly from Peoria steamfitters, has resulted in extensive improvements in the metal-working department of Bradley College, Peoria, Ill.

Classes are already filled to capacity and many others are seeking instructions. In the South Manual Arts building of the College work is being carried on at full speed. New electric and oxy-acetylene welding equipment and accessories have been installed.

Evening classes, mostly of employed steamfitters, are being held on Tuesday and Thursday nights. In charge of the evening division is Fred Dace, director; and Philip Becker, Jr., has charge of all metal-working classes. The course is of 14 weeks' duration.

Gold Prospectors Turning to Molybdenum Deposits

The demand for molybdenum, both for war-time requirements and in certain industrial lines, has so stimulated prices for this metal that today many engineers and prospectors who formerly were looking for gold properties are now searching for molybdenum deposits. Probably the outstanding molybdenum mine in the country is that owned by the Climax Molybdenum Co., of Climax, Colo., near Leadville, where there is a great mountain of it. This vast deposit of molybdenum is developing into a real mining sensation, and so rapid has been the advance in the price of this metal, together with recent growth in the knowledge of its valuable uses, that it is said the value of stocks in some of the principal molybdenum mines has jumped as much as one hundred points.

The Welding *of* Herculoy

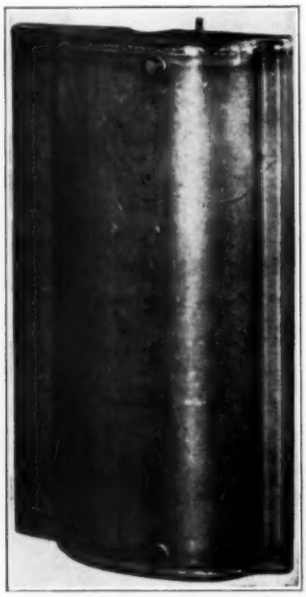
By R. STEINMETZ
Engineer in Charge of Welding,
L. Koven & Brother, Inc.

Part of Shipment of Welded Herculoy Tanks for U. S. Coast Guard.

AMONG the copper alloys developed to meet the requirements of immunity to rust and resistance to corrosion in industry, while providing at the same time the structural strength of mild steel, is Herculoy. This alloy, though introduced not so long ago, is of extensive potential value.

It is a copper-silicon-tin alloy, combining high strength, resistance to corrosion equivalent to that of copper and, what is of particular interest to our organization, ready adaptability to built-up welding construction.

In the past five years we have given an increasing amount of attention to the fabrication of built-up welded equipment for the chemical and allied industries, food-products plants, the marine field, machinery and metal-product manufacturers, and many other fields where the economies and improvements of this method of metal fabrication are particularly valuable. In most of these industries the problem of corrosion and the need for exceptional strength almost constantly present themselves, and it is interesting to note the increasing frequency with which we have had to deal with Herculoy as a construction material.



Ink Tank Welded From 10-Gauge Sheet.

Properties and Finish of Herculoy Are in Its Favor

Of course other physical properties of this alloy are factors in its selection. It is non-magnetic. It has a very pleasing appearance, taking a highly attractive gold-like finish, when polished. The metal is readily hot-worked; and when work-hardened for maximum hardness and strength, responds to heat-treatment for the relief of internal stresses. Not only does no loss of hardness or strength occur, but there is a material increase in its elastic limit, when this treatment is properly carried out. As a result, the metal can be used in a condition of maximum strength without the risk of stress-corrosion cracking. This alloy can also be readily worked cold.

Our experience with Herculoy has been extensive—not only on tanks, range boilers, pressure vessels of various types, etc., but on many special pieces of equipment. The ink pan illustrated in this article is a typical example of the wide range of special-purpose equipment on which this alloy has been used.

A recent experience in the use and welding of Herculoy may be both interesting and helpful. We were awarded the contract for the production of some thirty gasoline tanks to be used by the U. S. Coast Guard. They were 5 ft. long and 2 ft. in internal diameter, and made of 16-gauge Herculoy, fitted with two internal baffles of Herculoy and with Herculoy spuds for both charging and suction pipes.

The long seam on each tank was butt-welded. The dished heads were flanged, inserted in the shell and welded, and the spuds welded in place. The heads were spun, this operation being the most economical for us to use, although the metal could have been stamped or drawn equally satisfactorily.

The metallic-arc method was used on the butt weld for the long seam, and the carbon arc on the heads and spuds. No preheating of the metal was necessary. We used flat backing plates on the long butt-welds, but none were required for the welding of the heads or the spuds. The flux used was of the borax-fluoride type, in paste form. A Herculoy welding rod was used in reverse polarity—that is, work negative and rod positive.

Welding Speed Is Boosted to Insure Sound Welds

All welds on these tanks were completed in one pass, at as rapid a rate as possible. This question of speed is of importance in Herculoy welding, particularly with the metallic arc, in order to insure quality and soundness of the bead. All work was planned for welding in the down-hand position.

This job gave us no trouble whatever and resulted in a highly satisfactory finished product. Since polishing was not called for on the finished job, the bead was not finished off.

The ink tank shown in the accom-

panying photograph was welded of 16-gauge Herculoy, from suitably drawn units. It was built for special printing equipment using inks of unusually corrosive nature.

We have frequently hot-tin-dipped Herculoy tanks, to provide a suitable interior surface for the storage of drinking water.

Welded by Arc, Gas and Resistance Methods

Our work with Herculoy includes experience in welding by all the common methods—carbon arc, metallic arc, and the oxyacetylene flame, with occasional resistance welds. Most of it has been by the metallic-arc method, not only because a great deal of the jobs we have produced were in the lighter gauges, but because of our methods of utilizing the metallic-arc principle and our feeling that, properly carried out, this method is highly satisfactory and economical, both to our customers and to ourselves.

We briefly outline below some of the outstanding factors to be considered in the welding of Herculoy by various methods, including data on current, spacing, depth of bead, etc., furnished through the courtesy of the producers of this alloy.

Obviously work should be kept clean—free from grease, moisture, oil or dirt of any kind. Oxides and slag should be cleaned away whenever encountered.

In carbon-arc welding, preheating is unnecessary regardless of the thickness of the material to be welded. In metallic-arc welding material over ¼ in. thick, it is necessary to use coated rod and it may be necessary to preheat in order to obtain the penetration necessary for a good weld.

Work Should Be Clamped and Backed Up

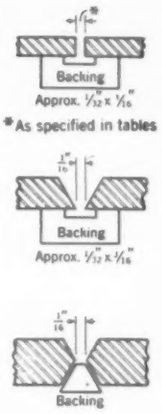
The work must be securely clamped or otherwise fastened, particularly on thin gauges. Backing plates should be used wherever possible, and always on light gauges. They may be of copper or Herculoy. For flush penetration the flat type of plate, securely clamped to the work, is used. Where a bead is required on both sides of the joint, we have used a grooved backing plate, so secured to the work that the groove coincides with the joint. The grooved plate is also advisable when the backing plate is to be exposed to molten metal at the bottom of the joint. This will avoid possible welding of the plate to the work and also insure complete fusion of the bottom edges. On thin sheets particularly, backing plates should be securely fastened to the work; used on top and about ¾ in. away from the seam, they minimize warpage.

Carbon-arc welds use direct polarity—work positive, electrode negative. Metallic-arc welds use reverse polarity—work negative, electrode positive.

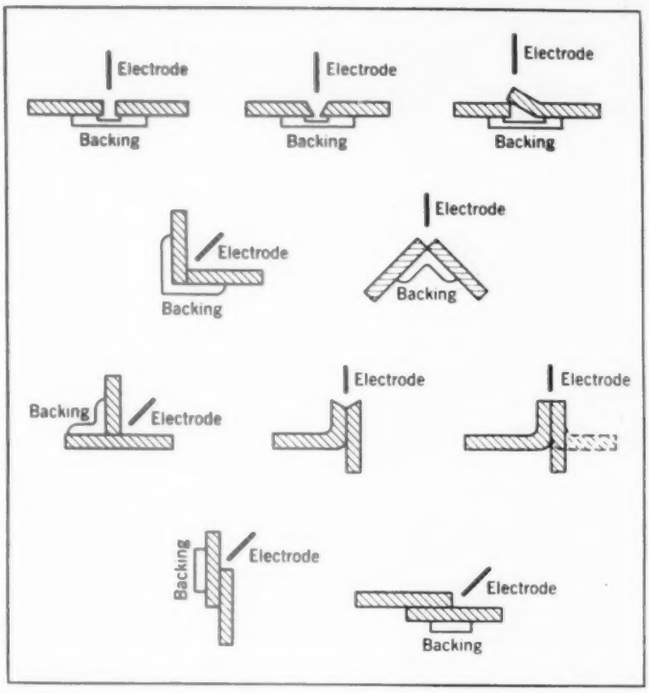
In welding material over ¼ in. thick, the weld can be completed in one pass with either the carbon or metallic arc, also without conditioning the edges. Material over ¼ in. should be welded with multiple beads, the number required depending upon the thickness of the plate. It is decidedly advisable, where more than one pass is necessary, to clean the previous pass thoroughly of all oxide and slag, using a chisel or air hammer. The best welds in multipass operations are obtained when each pass is completed before the next is started, each succeeding pass being carried completely across the width of the weld.

The bottom of the V in double-V joints should have efficient backing to prevent overheating of the first bead and subsequent possible cracking.

On heavy plate, the opening between plates in position for welding is most important. This opening, carefully selected to fit the nature of the plate,

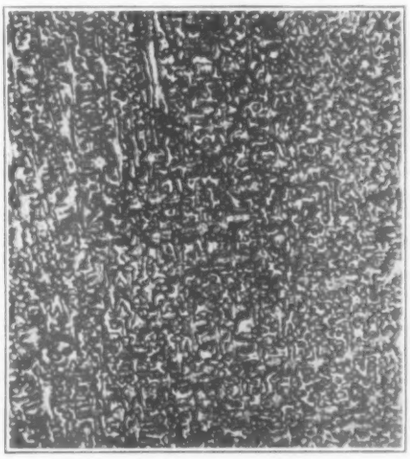


(Above) Preparation of Welding Edges.

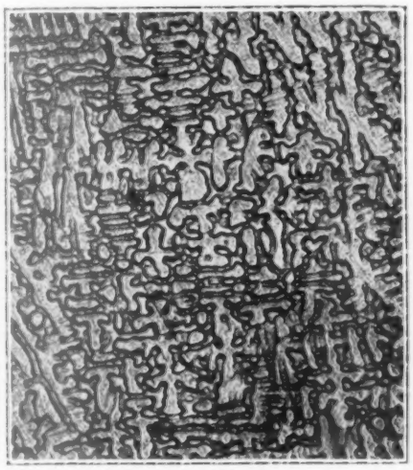


(Right) Proper Position of Work, Backing and Electrode.

CARBON-ARC WELD



METALLIC-ARC WELD



OXYACETYLENE WELD

Structures of Welds in Herculoy. (×75)

should be maintained by tacking the plates together at the joint at about 1-ft. intervals. This will minimize heat distortion.

When restarting a bead, we always begin on the old bead, about ½ in. back, to insure complete fusion and freedom from porosity. The quicker a bead is placed, with complete fusion, the better the soundness and quality of the weld.

Welding Should Be Limited to Downhand Position

Work should be positioned for downhand welding wherever possible, and overhead or vertical welding avoided. All cracks, gas holes, slag inclusions and the like must be removed by chipping whenever encountered, before continuing with the weld.

It will be recognized that the procedure outlined for the welding of Herculoy is contradictory to conventional welding technique, but the results obtained by inexpert operators and the ease and speed of effecting high-strength joints with remarkable ductility, substantiate its application.

Tensile specimens of welded heavy plates in the unmachined condition have fractured consistently outside of the welded area. Tensile tests of machined specimens fractured in the weld at over 50,000 lb. stress with an elongation of from 22% to 34%.

The structure of these carbon-arc welds are fine grained.

The theory is sound and practical.

It is generally accepted that overheating during the welding process is the cause of most of the failures of welds.

Physical Properties of Carbon-Arc-Weld Test Specimens of Herculoy

Metal Thickness	Tensile Strength, Lb. per Sq. In.	Remarks
0.625″	57,300	Fracture outside weld
0.250″	56,100	Fracture outside weld
0.250″	53,600	Fracture in weld
0.125″	60,800	Fracture outside weld
0.125″	58,500	Fracture outside weld
0.125″	61,400	Fracture outside weld
0.070″	60,000	Fracture outside weld

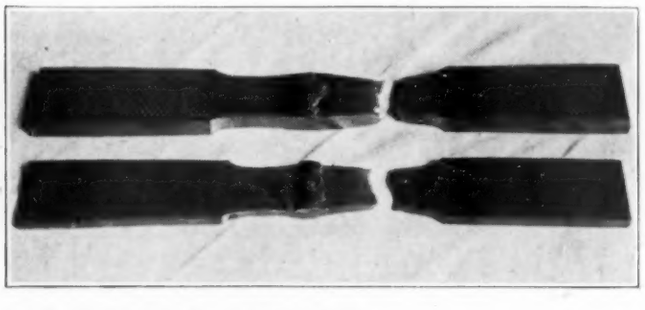
Data on Oxyacetylene Welding of Herculoy

Metal Thickness	Number of Beads		Welding Rod	Tip Size	Type of Edge
1/32″	1		1/8″	4	Straight butt
1/16″	1		1/16″	6	Straight butt, 1/16″ space
1/8″	1		1/16″	7	Straight butt, 1/8″ space
1/4″	1		1/16″	7	Single-V, 45° bevel
5/8″	1		1/4″	8	Single-V, 45° bevel
1/2″	1		5/32″	10	Single-V, 30° bevel
	2	1	1/4″	8	Single-V, 30° bevel
		2	1/16″	10	
5/8″	1		5/32″	11	Single-V, 30° bevel
	2	1	1/4″	10	Single-V, 30° bevel
		2	1/16″	11	
3/4″	1		5/16″	12	Single-V, 30° bevel
	3	1	1/4″	10	Single-V, 30° bevel
		2	1/16″	11	
		3	5/16″	12	

Data on Carbon-Arc Welding of Herculoy

Metal Thickness	No. of Beads	Bead Number	Welding Rod Dia.	Carbon Dia.	Welding Current Amps.	Type of Edge	Spacing Between Edges
1/32″	1	1	1/16″	1/16″	50	Flange or 1/8″ lap	------
1/16″	1	1	1/8″	1/16″	100	Straight butt	------
1/8″	1	1	5/32″	3/8″	160	Straight butt	1/16″
3/16″	1	1	1/4″	5/8″	220	Straight butt	1/8″
1/4″	1	1	5/16″	5/8″	280	Straight butt	5/32″
3/8″	2	1	1/4″	5/8″	240	Single V 30° bevel	1/8″
		2	5/16″	3/4″	300		
1/2″	3	1	1/4″	5/8″	240	Single V 30° bevel	1/8″
		2	1/4″	5/8″	280		
		3	5/16″	3/4″	350		
5/8″	3	1	1/4″	5/8″	240	Single V 30° bevel	1/8″
		2	5/16″	3/4″	330		
		3	5/16″	3/4″	350		
3/4″	4	Top V 1	1/4″	5/8″	250	Double V 30° bevel	1/16″
		Top V 2	5/16″	3/4″	350		
		Bottom V 1	1/4″	5/8″	280		
		Bottom V 2	5/16″	3/4″	380		
1″	6	Top V 1	1/4″	5/8″	250	Double V 30° bevel	1/16″
		Top V 2	1/4″	5/8″	280		
		Top V 3	5/16″	3/4″	350		
		Bottom V 1	1/4″	5/8″	280		
		Bottom V 2	1/4″	5/8″	300		
		Bottom V 3	5/16″	3/4″	380		

Arc to be lengthened until molten weld metal remains clear at arc contact.
Either double or single V joints can be used with the welding of Herculoy plates.
Single V is recommended for material 5/8″ thick and under, because the bead formed is not too wide, and it will not be necessary to chip out the bottom of the first bead.
Double V is recommended for material over 5/8″ thick, because of the greater possibility of including slag and oxides when weaving across a wide bead.
If construction will not permit double V on plates over 5/8″ thick, the single V joint is recommended.



Broken Tensile Specimens Welded With the Carbon Arc.

Although higher current values are used in this method the actual maximum temperature that the molten metal reaches is lower than is experienced in the accepted conventional welding technique.

The blending of the molten rod with both plate edges is effected almost simultaneously because of the long arc and higher current, thus permitting speedier welding.

Because of the fact that only 1/4-in. and 3/8-in. rods are used, the number of passes necessary to weld material over 3/16 in. thick has been cut at least in half. This, together with the lower price of these larger-diameter welding rods, is instrumental in lowering the cost of welding Herculoy to a very low figure.

The carbon arc can be used only with straight polarity. This is necessary because of the instability of the arc when the polarity is reversed. In fact, it would be impossible to execute a satisfactory weld by this method when reversed polarity is used.

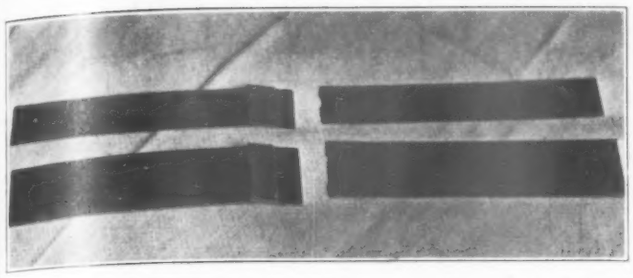
The size of welding rod used should be large enough to form the desired bead height without the necessity of building up the molten pool by insertion of the rod. If the rod used is too small, the arc must be concentrated too long on the molten area, possibly causing porosity and cracks, slowing up the welding operation, and raising its cost.

The application of the carbon arc resembles that of the gas flame since it furnishes only the heat for the welding operation. The carbon arc is silent, and is stable at much greater length than is the metallic arc. The fact that no spattering accompanies this method adds to the comfort of the operator.

Herculoy 1/32 in. thick can be welded successfully and with ease either with or without filler rod.

Flange joints on thin material can be welded without filler rod by melting down the flange to the base metal with the carbon arc.

When carbon arc welding with the use of filler rod, weave the arc across both edges until the sides of the V's start to flow. The end of the rod, which has been laid along the seam, is placed directly ahead of the arc core on the seam, or in the V. Then lengthen the arc until the weld metal when in a molten condition is bright and free from



Typical Fracture of Stitch-Welded Specimens.

oxides. Continue along the joint as quickly as fusion permits.

The arc length, dependent upon the size of rod and plate thickness, is usually from ½ to 1 in. This long arc is most important as it serves as an efficient preheating and blending element.

Freedom from porosity is mostly dependent upon speedy welding, which in turn is dependent upon a long arc and sufficient current.

Recommended sizes of rod, electrodes, current density, etc., for use in welding Herculoy, and physical properties of tested Herculoy carbon-arc welds, are given in accompanying tables.

Herculoy can be successfully welded by the oxyacetylene flame, but the following pointers on the use of this method deserve careful attention.

In butt welding, attach backing plates to only one plate, by brazing or welding. This permits free expansion and contraction both while welding and while cooling off.

Procedure for Welding With Oxyacetylene Flame

Multiple beads should be used on all work above ½ in. thick. Work should be cleaned of all slag and oxide between beads and refluxing always resorted to. The work should be inclined, wherever possible, about 30°. The flame should be neutral or only slightly oxidizing. The weld should be started about 2 in. from the end of the seam and worked backward, maintaining as small a molten pool as possible. This tends to end the cracking of the bead behind the flame.

Each bead should be completed along the entire length of the joint before proceeding with the following bead. The flame should be played directly into the V of the joint, weaving it across the sides, when bevelled plates are welded, to insure suitable penetration. Bead quality is best assured by welding as rapidly as possible.

General recommendations for oxyacetylene welds are given in an accompanying table.

Herculoy will stitch weld very satisfactorily. The following table gives physical properties of typical resistance welds on Herculoy.

Physical Properties of Stitch-Welded Specimens of Herculoy

Weld No.	Metal Thickness	Tensile Strength Lb. per Sq. In.
1	0.041″	73,300
2	0.042″	68,200
3	0.044″	63,700
4	0.044″	63,200
5	0.044″	64,400
6	0.043″	61,300
7	0.043″	63,300
8	0.043″	68,200

All fractures at edge of welds.

Metallic-Arc Can Be Used for Thin Gauges

Although not recommended as general practice for the welding of material over ¼ in. thick, thinner gauges can be welded with comparative ease.

If heavier plates are to be welded by this method, coated rod should be used to prevent the arc from being diverted to the sides of the V'd edges, which would result in insufficient penetration and uneven deposition of the weld metal.

In the metallic arc welding of Herculoy, it is necessary to use reversed polarity and a comparatively short arc. A voltage of 25-35, dependent upon the rod size and thickness of plate, gives the best results. It is important that the arc be concentrated partly ahead of the bead in order to prevent localized building up of the bead beyond normal height, which may cause cross-bead cracks, and to obtain proper penetration.

For these reasons speed is essential.

Recommendations for metallic-arc welding, and physical properties of some tested automatic metallic-arc welds on Herculoy, are given in accompanying tables.

The use of Herculoy welding rod is advisable on welding work with this alloy. It has a tensile strength of 65,000 lb. per sq. in., and an approximate melting point of 1800° F.

Technique Varies With Thickness of Metal and Type of Joint

In our experience, which covers built-up welded work on sheet and plate, in practically every commercial metal and alloy capable of being welded, we can say that the welding of this alloy has given us little trouble, once we became familiar with the technique required and with the modifications in practice required by varying thicknesses of metal and by various types of joints. Its strength and corrosion-resisting properties lend themselves admirably to a wide range of equipment, both standard and special, where these characteristics are of paramount importance.

As we see it, the values of this and similar alloys will become increasingly appreciated in the years immediately ahead and they will undoubtedly become much more widely used for pickling tanks and baskets, boilers, kettles, mixers, screens, blowers, fans, ducts, pumps, manifolds, sash and skylights and a host of other common and out-of-the-ordinary pieces of process and structural equipment on which special operating conditions have to be met. This will be particularly true of all such equipment on which the principles of built-up welded design, with its inherent economy, greater strength and improved appearance, can be utilized.

Recommended Currents for Welding Herculoy Plates and Sheets With the Metallic Arc

Metal Thickness	Voltage: Closed Circuit	Amperage: Closed Circuit	Electrode Diam.
1/16″ and under	25 — 30	100 — 125	1/8″
1/8″	25 — 30	150 — 175	5/32″
3/16″	25 — 30	200 — 225	5/32″
1/4″	30 — 35	250 — 275	1/4″
Over 1/4″	30 — 35	275 — 350	1/4″ — 5/16″

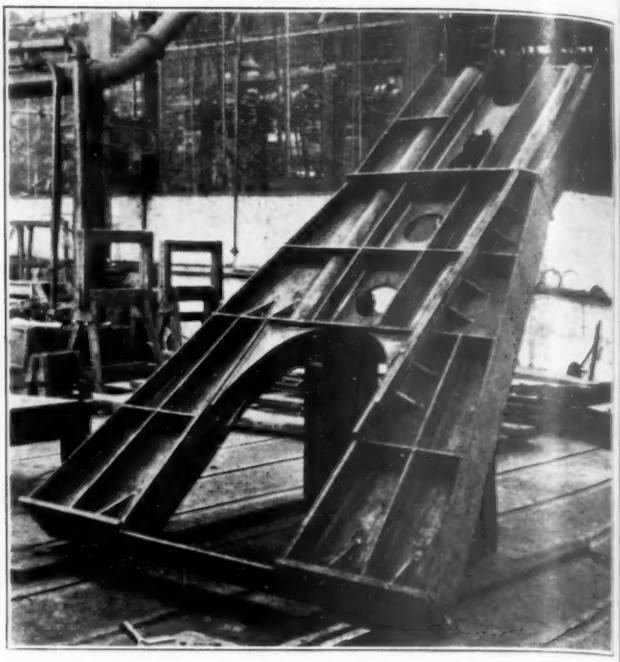
Physical Properties of Automatic Metallic-Arc Welds

Metal Thickness	Backing Plate	Electrode Diameter	Amperes	Speed, In. per Min.	Tensile Strength Lb. per Sq. In.*
0.083″	Grooved Copper	1/8″	150-220	21	†68,300
0.083″	Flat Copper	1/8″	150-220	21	66,700
0.083″	Flat Copper	1/8″	200-225	22.5	67,000
0.083″	Flat Copper	1/8″	200-225	25	64,200
0.083″	Flat Copper	1/8″	200-225	30	65,500
0.065″	Flat Copper	1/8″	150-200	32	67,000
0.055″	Flat Copper	1/8″	125-175	32	59,500
0.055″	Flat Copper	1/8″	125-175	32	59,200
0.055″	Flat Copper	1/8″	100-150	20	59,800
0.055″	Flat Copper	1/8″	125-175	30	66,900

A voltage of 25-30 was maintained.
*These values are the averages of 3 tests on each weld.
†The greater tensile strength of this first weld over the other welds is due to the additional bead formed on the reverse side of the weld.
All fractures occurred at edge of welds.

Making Neat Flame Cuts in Stainless Steel

Flame cutting of various stainless steels can be facilitated by laying a metallic-arc bead along the line of cut and then applying the cutting torch. A recent number of the *A.E.D. Bulletin*, issued by the Air Reduction Sales Co., describes cutting tests made on intricate shapes, in which excellent cuts were made, nearly equal to steel cuts, by arc welding with a suitable steel electrode along the line of the proposed cut. The deposited bead was then cut with a torch lengthwise. Where good penetration is obtained, a fine cut will result.



One of Main Columns for 4,000-Hp. Diesel Engine Built Entirely of Welded Steel.

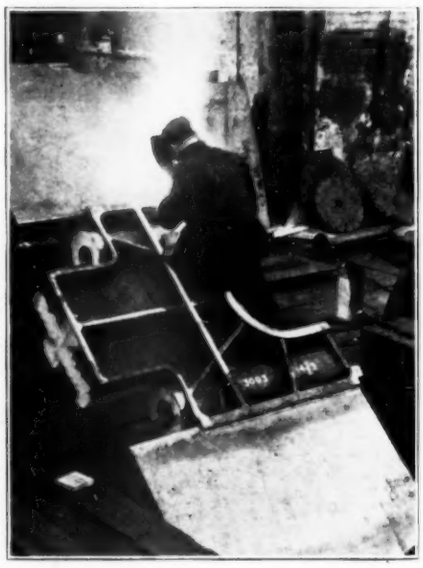
Twice the Power— No Increase In Space

By A. F. DAVIS
Vice-President, The Lincoln Electric Co.

WHAT is probably one of the greatest forward steps in the Diesel engine since its invention was noted recently in England when a new engine, built to replace a unit in a motorship, doubled the power of the vessel, yet required no more space than the original unit.

The new engine is rated at 4,000 b.hp. at 109 r.p.m., but actually develops 4,400 b.hp. This new Diesel engine is of the double-acting, two-stroke, 4-cylinder type, and has a bore of 27½ in. and a stroke of 47½ in. It was built by Richardsons, Westgarth & Co. for the motorship *Silverlarch* of the Silver Line. The *Silverlarch* is one of two vessels which the owners are having reconstructed by J. L. Thompson & Sons, Sunderland, England, to provide increased speed.

Construction of an engine having such a high ratio of power to size has been made possible by improved design employing steel and arc welding. Major parts such as bedplate and columns, as well as scavenging-air main, crankcase covers and plates, and exhaust pipe, are all built of arc-welded steel plate. The use of welded steel provides high strength and rigidity with small size of members and low weight. This advantage enabled the builder to obtain a structure double the capacity possible with a suitable form of cast iron construction.



Welding a Steel Plate to the Cast Steel Bearing Housings.

The bedplate is of special interest in view of the engine's power and its comparatively low speed. The length of the bedplate is 22 ft. 6 in., width 14 ft. and depth 5 ft. 4 in. It is of the tank-top type.

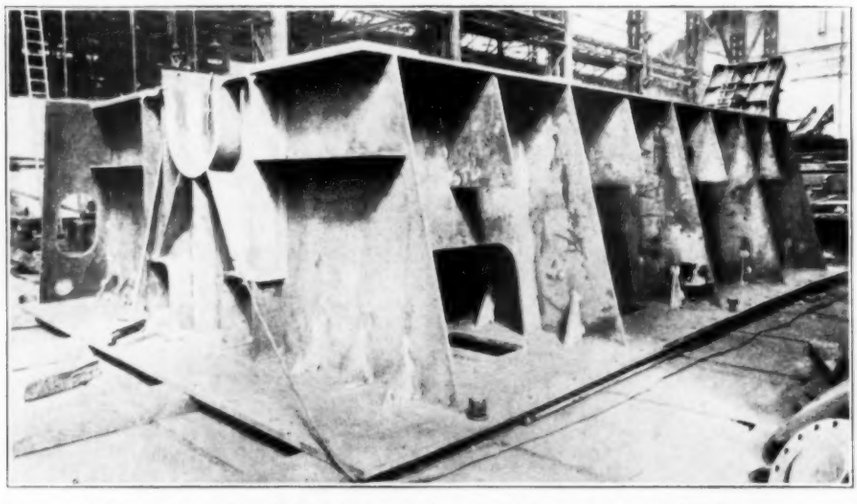
The bottom plate consists of two lengths of steel plate double-butt-welded together longitudinally. To obtain maximum rigidity, the sump is welded integral with the bedplate.

The main columns are made up of a number of pieces of steel plate fused into one integral unit by welding.

The cast steel bearing housings are fixed in the bedplate by steel plates welded to them and to the sides and bottom of the bedplate.

All welds in construction were made in two passes. In the case of the butt welds, the first pass was made with ¼-in. electrodes and the second with 5/16-in. For the other welds, 3/16-in. and ¼-in. electrodes were used.

Although the aim of the builder was to obtain a structure of maximum rigidity at moderate cost without any particular emphasis on lightness, the saving in weight was large. The bedplate weighs approximately 33% less than would be possible with suitable cast-iron construction. Actual weight, arc welded, is 29½ tons. Weight, in cast iron, would have been 44 tons. Cost savings were



View of Arc-Welded Bed Plate Before Applying Side and End Plates.

Using Welded Steel, the Bed-Plate Weight Was Cut One-Third.

also considerable, due to elimination of patterns and pattern drawings and to simplified machining.

The new engine was designed by W. S. Burn, representing the builders, and recently underwent test-bed trials.

Meetings

Chicago

"Designing for Welding" is the subject of a talk that will be given by E. W. P. Smith, consulting engineer, The Lincoln Electric Co., Cleveland, Ohio, at the meeting of the Chicago Section, American Welding Society, to be held on Friday evening, Apr. 24, at Armour Institute of Technology. Mr. Smith will illustrate the effect of design on stress concentrations, using the polariscope and rubber models. The meeting on Friday, May 22, will be devoted to "Weld Testing and Inspection."

A demonstration of welding with the carbon arc was given by Harry K. Miller, Chicago representative of Hobart Bros., at the first meeting of the 1936 season to be held at the Welders' Information Center, 741 West 70th St., on Apr. 7. At the meeting on Tuesday, May 5, a demonstration of the Aladdin a.c. arc-welding unit will be made by the Maywood Electric Co., of Maywood, Ill.

Cleveland

The Cleveland School of Welding, Cleveland, Ohio, will hold "open house" on Wednesday, Apr. 29, beginning at 8 p. m. The program includes a motion picture entitled "Yesterday's Standards" and a talk by J. H. Blankenbuehler, of the Westinghouse Electric & Manufacturing Co. on the FlexArc welder.

Detroit

Developments in resistance welding, and new applications, was the subject of a talk by M. S. Clark, of the Taylor-Winfield Corp., Warren, Ohio, before a meeting of the Detroit Section, American Welding Society, held on Mar. 27.

Los Angeles

The Los Angeles Section of the American Welding Society will hold its regular meeting on Friday evening, April 24, in the banquet room on the ninth floor of the Los Angeles Chamber of Commerce Building, at 1151 S. Broadway. A short business session will follow the usual 6:30 dinner, after which there will be a "Non-Ferrous Welding Clinic" given by the Pacific Metals Co., at 1400 S. Alameda St., where demonstrations in gas and electric welding of aluminum and aluminum alloys, copper and copper alloys, nickel, monel, and nickel-clad steel will be given.

At the March meeting of the Los Angeles Section, in addition to the program as announced in the February issue of *The Welding Engineer*, an extra feature was a talk by L. Lowell Johnson, Credit Union Section, of the Farm Credit Administration, Washington, D. C. Mr. Johnson spoke on "Nonmetallic Welding," or, in other words, the bonds of financial security through co-operative effort of fellow workers. This talk presented the history and organization of credit unions in a vivid manner which occasioned extensive discussion.

Milwaukee

"Low-Alloy Steels" is the subject of a talk by A. E. Gibson, vice-president of The Wellman Engineering Co., of Cleveland, O., to be given before the Milwaukee Section, American Welding Society, on April 17.

New York City

"The Thermal Treatment of Welds" is the subject of a talk by Dr. J. C. Hodge, of The Babcock & Wilcox Co., to be given at a joint meeting of the New York Section, American Welding Society, with the American Society for Metals, to be held at the Hotel Pennsylvania, on Apr. 20. At the meeting of the New York Section on Apr. 14, a talk on "Welding Practice in the Bureau of Navigation and Steamboat Inspection" was given by James W. Wilson, traveling inspector of the Bureau.

San Francisco

At the meeting of the San Francisco Section of the American Welding Society held on Mar. 20, a sound picture of the construction of the Oakland-San Francisco Bay Bridge was shown. This picture, furnished through the courtesy of the Columbia Steel Corp., told in pictures the growth of the bridge, while the "talkie" explained the various features as they were shown on the screen. Immediately following, a technical paper was presented on the subject "Hydrocarbon Fuel Gases for Cutting." The paper was by Dr. G. V. Slottman, combustion engineer for the Air Reduction Sales Co., New York, and was illustrated with slides. Following the program, the meeting was adjourned to the class rooms of the high school, where members and guests inspected the work done by students in welding.

Midwest Clinic Slated For June 4-5-6

The Midwest Welding Clinic, consisting of welding and cutting demonstrations, exhibits of welded parts, and a program of papers and discussions, will be held in Chicago on Thursday, Friday and Saturday, June 4, 5 and 6, in the Westinghouse warehouse at 2211 W. Pershing Road. Those participating in the clinic include the Hollup Corp., Westinghouse Electric & Manufacturing Co., The American Brass Co., Burdett Oxygen & Hydrogen Co. (unit of Compressed Industrial Gases), and American Manganese Steel Co. A number of other companies, including the American Steel & Wire Co., will assist in the demonstrations.

A display space of 109x49 ft. will be given over to demonstrations and exhibits, and in addition a lecture hall on the same floor will be at the service of visitors and exhibitors. A great deal of thought and attention is being given to the papers program, which will be published in the May issue of *The Welding Engineer*.

Welded Railroad Gondola Makes Emergency Boat

Among the tales that emerged from the recent disastrous floods in the Eastern part of the country, is one concerning a resourceful welder in a town on the Ohio river who took time by the forelock and made a boat out of a gondola freight car, using his welding equipment. According to the story, related by Robert E. Kinkead, in *Steel*, the welder cut the car loose, and then welded the seams tight. When the water rose over the railroad yard, the newly welded barge floated, and he and his neighbors poled the vessel over to their homes, which were in danger from the rising waters. That freight-car body is now high and dry, 1,000 ft. from a railroad and a mile from the river.

Resistance Welding—IV

Theory and Application . .

(Fourth of a series of articles)

By L. H. FROST

Welding Engineer, The Electric Controller & Mfg. Co.

THE cheapest way to fabricate many parts is by means of spot, butt or projection welding. An example of this is the bracket shown in Fig. 13. The first design of this bracket (see A) consisted of machining, drilling and tapping an iron casting. This was costly to produce, and there was considerable expense for the pattern and jigs. With the assistance of the welding engineer, the design was changed to that shown in B.

In considering the design of the cast-iron bracket, it is apparent that there are a number of shop operations required as follows: First, the bottom must be faced off; second, the piece must be reversed and the shoulder shank and top surface machined; third, a drilled and tapped hole must be made in this top surface; fourth, the two mounting holes must be drilled and countersunk.

The first three operations were done in a screw machine, the work being held by a special chuck. The last operation was done in a drill press by using a drill jig.

The casting has a black-enamel finish and Parkerized exposed metal surfaces.

The bracket shown at B consists of a plate to which is welded a screw-machine part. The plate itself is a punching, and the unit has been cadmium plated. In C, the bracket is shown at the completion of the welding operation, and D shows the part broken under test to illustrate the high strength of the weld.

The finished cast iron bracket weighs 3½ oz. and the welded bracket 2¼ oz.

The following is a summary of the cost of each design:

CASTING		WELDED	
Tools		Tools	
Spl. chuck	$10.00	Die	$10.00
Drill jig	20.00	Cut-off	5.00
Pattern	50.00	Welding dies	5.00
Total	$80.00		$30.00
Finished cost of part, not including cost of tools and pattern	$ .27		$ .13

Thus, the welded part is less expensive. Also, it is more adaptable to change, since alterations would be minor ones and easily made.

In analyzing the welded design, it is obvious that it does not fall into the class of spot welding or of butt welding. It is, however, easily accomplished by projection welding. This projection is in the form of a small boss, ⅜ in. in diameter and 0.02 in. high, on the bottom of the screw-machine part. The plate to which it is welded is ⅛ in. thick. By referring to Fig. 4*, it is evident that 50-kva. input at 30 cycles would be a reasonable starting point.

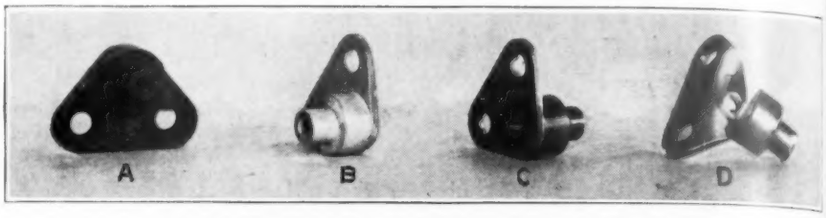


Fig. 13. Views of Cast Bracket and Welded Bracket.
(*A*, cast-iron bracket; *B*, welded bracket, cadmium plated; *C*, welded bracket before plating; *D*, part broken under test, to show strength of weld.)

Since in projection welding additional time must be allowed for upset, as in butt welding, it is evident that more than 30 cycles will be required for the complete weld. In actual production a measured input of 50 kva. was used and it was found necessary to allow the current to flow for 80 cycles.

The parts could have been welded by other arrangements of projections, but this design was believed most satisfactory for the particular conditions. Since only a relatively small number of these parts were to be run on the first production, the welding die was not surfaced with a hard copper alloy. The above figures were based on a quantity of 500. If more than this quantity is made it will be necessary to use some material such as Elkaloy or Mallory No. 3 to make the surface more durable.

Other projection welding problems may be analyzed in a similar manner, but in figuring costs it is necessary to give some thought to the methods which will be best suited to the particular shop.

*See "Resistance Welding—II," by L. H. Frost, page 38, *The Welding Engineer*, Feb. 1936.

News of Welded Pipelines

The Phillips Petroleum Co. has just completed an all-welded 24-in.-diameter gas line in Texas. The line, which is some 23 miles in length, extends from the company's holdings in the Sun-Ray gas area in Moore County, to its natural gas plant, near Sanford. It will carry sour gas of high hydrogen-sulphide content to a gasoline plant and carbon-black plant, and its maximum capacity is expected to exceed 150,000,000 cu. ft. With but the one exception of a river crossing, where couplings were used, the line is shielded-arc welded throughout.

In welding the line, 40-ft. lengths of pipe, three to five in number, were lined up on rollers and tack-welded together. Pipe ends were beveled and the joints welded by three passes, or beads, as the pipe was rolled. The 120- to 200-ft. welded sections were then lifted by tractors with winch and overhanging beam and lined up with the last section placed in the ditch. Sections were joined by bell-hole welds. Welding was also used to obtain changes in angles of the line instead of bending the pipe. The welding was done by H. C. Price, Inc., of Bartlesville, Okla.

* * *

A contract for the arc welding and laying of 107 miles of 20-in. natural-gas pipeline for the Northern Natural Gas Co., of Omaha, Nebr., has been awarded the Truman-Smith Construction Co., Eldorado, Kan. This line will parallel the company's old line from the Stevens County gas fields near Hugoton, Kan., up to their booster station at Mullinville, Kan. The pipe will be welded into 80-ft. sections and then be joined with Dresser couplings before being lowered into the ditch.

The Truman-Smith company are also welding and laying a considerable amount of pipeline of sizes from 24 to 2 in. for the Phillips Petroleum Co., at Oklahoma City, Okla. This is the first job on which the company have done their own electric welding.

* * *

A 15-mile trunk line, of 2½- and 3-in. standard pipe, is to be laid for the San Diego Consolidated Gas & Electric Co., between Carlsbad and Escondido, Calif., to carry natural gas at a peak pressure of 400 lb. per sq. in., according to a report from The Linde Air Products Co., New York City. It is claimed that the pipe will be welded by the Lindeweld process, and work on it will start May 15.

* * *

A contract for arc welding 172 miles of 22-in. pipe for the Michigan Gas Transmission Corp.'s line from Muncie, Ind., to Detroit, Mich., has been awarded H. C. Price, Inc., of Bartles-

ville, Okla. The W. S. Bibb Contracting Co. are the general contractors.

* * *

Contracts have been awarded for 4,375 tons of steel plates for two welded steel pipelines (a 60-in. and a 20-in.) for the city of San Francisco, Calif.

* * *

Plans are being completed for the early commencement of a 378-mile 10-in. welded natural-gas pipeline to extend from the Southwestern Kansas gas field to McCook and Grand Island, Nebr. The line will cost about $5,000,000.

* * *

Construction will soon be launched on a third welded oil pipeline from the Kettleman Hills oil field in California, to Estero Point, just north of Morro Bay. Preliminary engineering work on the project is now under way.

Notes on Metal Spraying

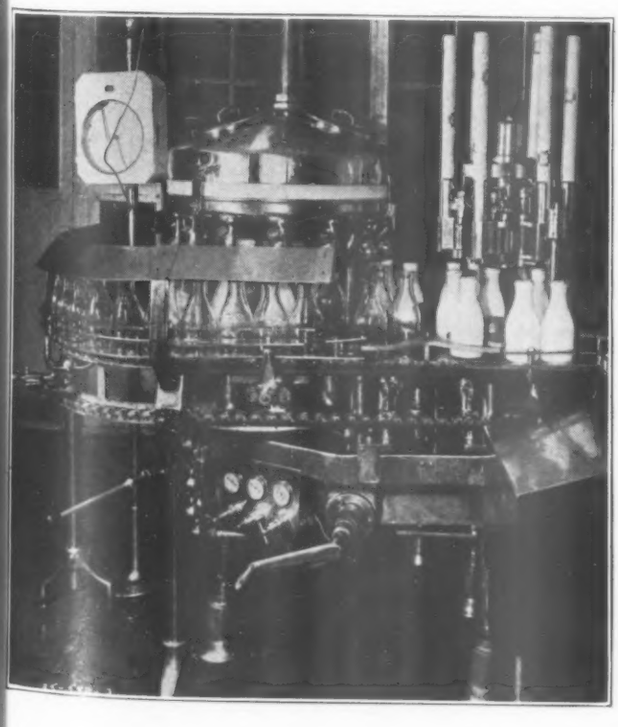
Polishing 18-8 Stainless Coatings

The practicability of polishing "Metallized" coatings, especially the harder metals, has generally been considered as an obstacle difficult to surmount, because of the expense involved, and further because the human element, insofar as the actual polishing operation is concerned, is a prolific cause of trouble, says W. C. Reid, Metallizing Engineering Co., Inc., 205 W. Wacker Drive, Chicago, Ill.

Two of the most common troubles which can be attributed to the human element are excessive heat, generated locally, which causes blistering; and excessive pressure on the edges of the grinding and polishing wheels, which causes the coating to be cut through in spots.

A further cause of trouble is the fact that the characteristic granular structure of "Metallized" coatings calls for special wheels and compounds, states Mr. Reid. For instance, in plain cylindrical grinding of stainless steel, certain wheels are recommended by the abrasive manufacturers, which wheels will not efficiently grind the same metal after it has been deposited by the "Metallizing" process. The same thing applies to polishing, and considerable experimental work has been done towards finding suitable polishing compounds.

Mojonnier Brothers, of Chicago, Ill., have a "Metallizing" department working on a production basis. In this department, they render a great many parts immune to the ravages of corrosion due to moisture and atmospheric conditions, with very evident success. The castings used in the Model 90 Majonnier Vacuum Milk Bottle Filler are "Metallized" with 0.032 in. of 18-8 stainless steel and polished to a mirror finish. This is a practical illustration that polishing "Metallized" stainless steel can be worked out; and with the cooperation of the manufacturers of abrasive, the field for this work will widen and the cost decrease in proportion.



All Castings in This Milk-Bottle Filling Machine Were Sprayed With Stainless Steel and Then Polished.

Sprayed Lead Resists Acid Fumes

After two years' service, a rotary drier, lined with lead, metal sprayed, is standing up so well that the owners have recently decided to lead-line another dryer of a similar type, this work having been done in January of this year, says H. B. Rice, of the Metalspray Co., Inc., Los Angeles, Calif.

The first application, made two years ago, involved the spraying of 1,000 lb. of 4%-antimony lead to 600 sq. ft. of the internal surface of the dryer, which is 100 ft. long and 9 ft. in diameter. This footage was entirely included in 20 lineal feet of this dryer. The coating was between 0.018 and 0.020 in. thick. A sand-blast bond was used, and ventilation was very efficiently provided by a blower at one end of the dryer.

The purpose of this application was to resist corrosion due to hydrochloric-acid fumes. During only 8 hr. of service, the thickness of the plate, before lining with lead, would be reduced 20% or 25%, and in places as much as 40%.

The recent job involved an application of 4,500 lb. of ⅛-in. 4%-antimony lead to 2,000 sq. ft. of another dryer of the same size. This area was included in the 70 lineal feet farthest from the oil burners, thus protecting the greater portion of the corroded areas of the dryer.

Coming Events

May 4-9. Detroit, Mich. Foundry and Allied Industries Exposition. Also annual convention of American Foundrymen's Association. For information write the Association, at 222 W. Adams St., Chicago, Ill.

May 16-23. Tulsa, Okla. Ninth International Petroleum Exposition and Congress. For information write Wm. B. Way, care of Exposition, Tulsa, Okla.

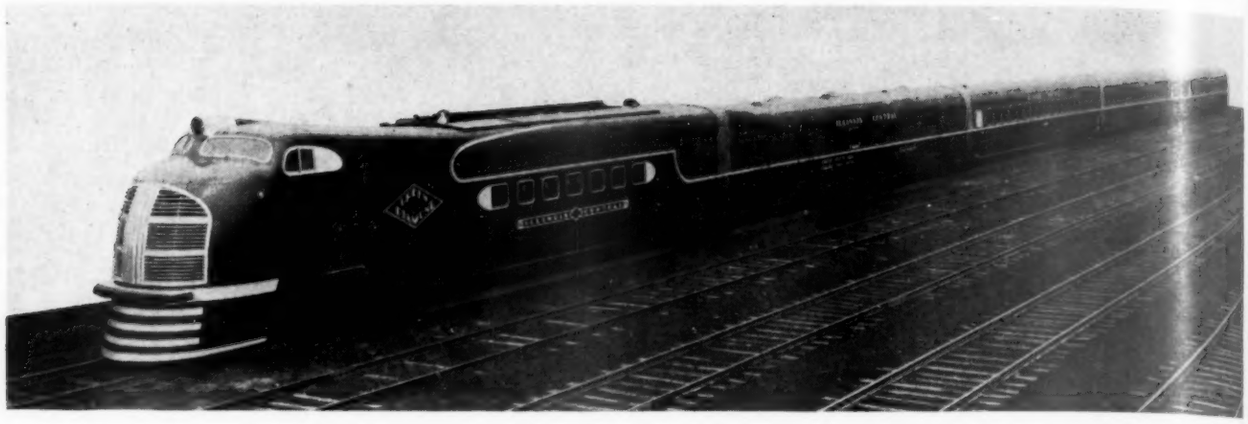
May 25-27. Philadelphia, Pa., The Bellevue-Stratford. Annual Convention of the Heating, Piping and Air Conditioning Contractors National Association. For information write the Association, at 1250 Sixth Ave., New York City.

June 27-Oct. 4. Cleveland, Ohio. Great Lakes Exposition. For information write Ernest Smith, 3910 Carnegie Ave., Cleveland.

June 29-July 3. Atlantic City, N. J., Chalfonte-Haddon Hall. Annual meeting American Society for Testing Materials. For information write Society at 260 S. Broad St., Philadelphia, Pa.

Sept. 22-25. Detroit, Mich. Iron and Steel Exposition. Also annual convention of Association of Iron & Steel Electrical Engineers. For information write John Kelly, Jr., Empire Bldg., Pittsburgh, Pa.

Oct. 19-23. Cleveland, Ohio, Public Auditorium. National Metal Congress. Also Fall Meeting of American Welding Society and meetings of American Society for Metals, Wire Association, and others. For information write W. H. Eisenman, 7016 Euclid Ave., Cleveland.



Light-Weight, Stream-Lined Train Employs Many Arc-Welded Details . . .

A FIVE-CAR articulated stream-lined train was recently built by the Pullman-Standard Car Manufacturing Company of Chicago for the Illinois Central Railroad, who will place the train in service on the run between Chicago and St. Louis.

A considerable amount of welding was used in some of the important members and connections of the cars, and also of the car frames, and in the construction of the 1200-hp. Diesel engine with which the train is powered.

Special Construction Cuts Weight in Half

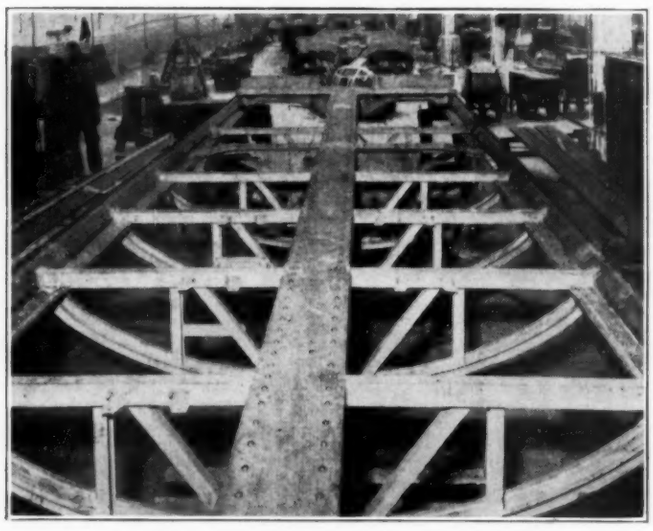
The train has an over-all length of 328 ft. 6 in. and consists of a power car, a mail-baggage car, two chair cars, and a dining-lounge car in the rear. The train has a total passenger seating capacity of 120, in addition to 24 seats at dining tables and 2 seats at writing desks. Its total weight, light, is 476,800 lb., or about one-half the weight of a conventional train, consisting of a locomotive, baggage car, two chair cars, and rear car. The framing members and sheets are of Cor-Ten.

Train Has 6,800 Lineal Feet of Arc Welding

All told, 4,581 lineal feet of arc welding was used in the trailing cars, and 2,230 ft. in the power car.

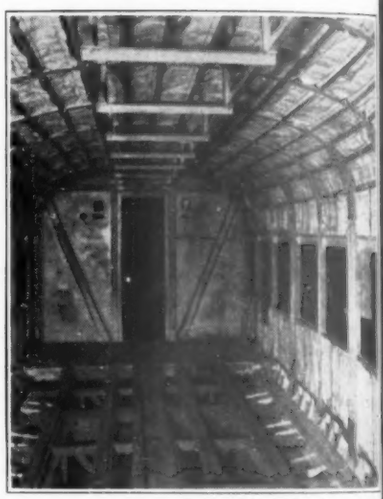
The underframe assemblies of the trailing cars are a combination of riveting and spot welding. Welding was used for joining the center sills to the end sills, stiffeners to floor beams, bottom-sheet stiffeners, reinforcements to center sills and miscellaneous equipment supports, body side-bearing wear plates and jacking beams, and pockets over the trucks.

In the side and roof framing, welding was employed in the sashrests, window headers, letterboard stiffeners, as well as purline and carline connections.



The Underframe Is Largely Welded, Though Some Rivets Are in Evidence.

(Welding was used for connecting sills, beams, stiffeners, reinforcements, wear plates, jacking beams, and in the pockets over the trucks.)



Interior View of Car.

(Besides the flooring, sides and roof, considerable welding was also used in the end framing.)

The end frames at the articulated ends are a combination of welded and riveted construction. The corner posts were welded to the end sills, end posts welded to the end sills and to the end plate, diagonal braces welded to the end sills and corner posts, and miscellaneous reinforcements welded on the ends of the cars. The end sills are of all-welded construction, and are riveted to the framing members.

The usual side plate construction is supplemented by a built-up shoulder construction, which is a combination of welded and riveted members. The shoulder construction between the letterboard and roof sheets is of welded construction, though riveted in place. It was assembled first by being fitted to the car full length, and tack welded, after which

it was removed and the joints welded on both sides, then disked and ground and reapplied to the cars in one piece.

In the rail-end car the corner posts are welded to the end sills, end posts to the end sills and end plate, and diagonal end braces to the corner posts. On the rear end of the car the channel posts at the door are welded to the platform casting and to the top end framing, also the rear-end hood framing and miscellaneous reinforcements are welded.

The 9-in. side posts are of built-up pressed channels, with the vertical angles spot welded to the channels and the inside-post pressed channels tack welded. The 5-in. and 3½-in. posts are of pressed channels with the inside-post pressed channels tack welded. All posts, also both top and bottom covers, are welded to the side framing members and to the inside channels. Where box sections are used, these are formed by welding after the side posts are set in place.

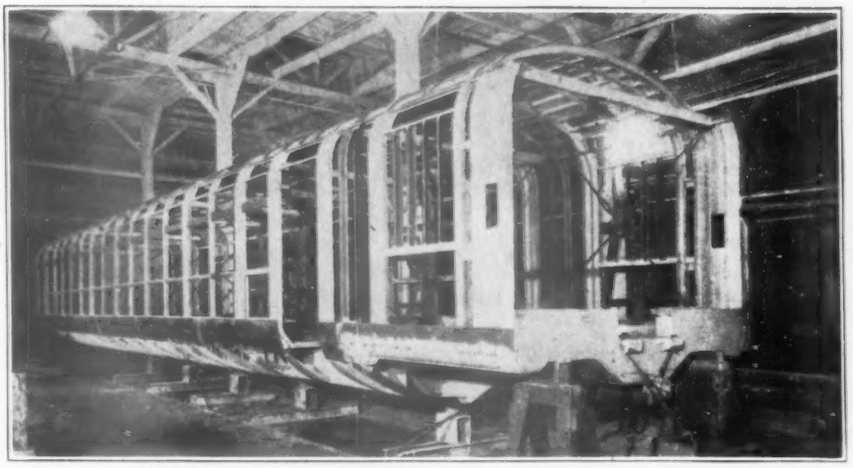
Details of Welding in Power Car

In the power car, welding was used in the side and roof framing, rear-end framing, underframe, front-end assembly, removable roof, and body bolster sub-assembly.

In the side and roof framing, the side-post connections were welded to the side sills and side angles to the side posts. All the side-post stiffeners were welded at the belt rails, side-post reinforcements were welded, and welding was also used in the girder sheet wedges on the side posts, and reinforcements at window openings. Reinforcements on the roof sheets and purlines were welded to the carlines.

In the rear-end framing, the end-sill cover plate was welded to the posts, end posts welded to the end plate and floor plate, reinforcement welded to the end plate, and welding was used all around the joints of the end sheets to the corner posts.

All joints at the butt splices of the roof sheets, girder sheets, pier panels, letterboards and bottom sheets were welded, ground and disked. The side plate covers in the power car were made up the same as for the trailer cars.



Welded Framing in Sides and Roof of One of Trailer Cars.

In the power-car underframe welding was used in the end-sill assembly at the car, jacking beams, side-sill stiffener angles, bottom-sheet supports and connections to center sills, center-sill and side-sill separators, platform supports and side-sill stiffeners, bolster at the front end and center-sill separators, as well as for miscellaneous floor supports, stiffeners and equipment supports.

The front-end assembly at the car includes a welded front-post assembly, welded side-post assembly at the shutter frames, welded front-sill cover plate, also pilot, shutter channels, bumper assembly and miscellaneous brackets, all of which were welded.

In the removable roof, the roof framing Z's, roof tapping plates, radiator hangers and bosses, are welded.

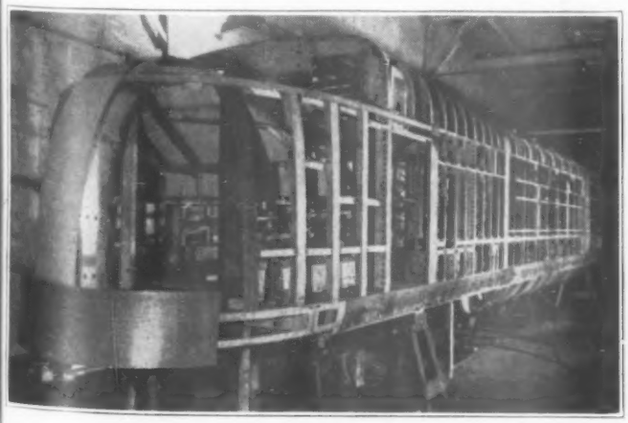
Welding Employed in Engine and Engine Base

The cylinder block and crankcase of the main Diesel engine are combined into one unit of the latest welded steel construction.

The engine base of this power plant is of a unique design. This structure incorporates in a single welded steel assembly a sub-base for mounting the coupled engine and generator, and a fuel supply tank.

The body bolster sub-assembly was built-up and welded in jigs, ready for application to the car.

Welding was also used in miscellaneous parts. For example, all the conduit joints were welded at the couplings and junction boxes, the removable bottom door frames were welded, as was the step well framing, air conditioning system, motor-base support and framing, and all fresh-air intakes.



Power-Car Framing.

(Many of the joints in the side, roof and rear-end framing were welded.)

Santa Fe Orders Stainless Steel, Light-Weight Train

An 8-car, light-weight, stainless-steel train has been ordered from the Edward G. Budd Manufacturing Co., Philadelphia, Pa., by the Atchison, Topeka & Santa Fe Railway for weekly round-trip service between Chicago and Los Angeles. It is claimed that this new train will cut 14 hours off the present running time between these two cities. This train will weigh only about half as much as a comparable conventional train, yet the safety factor is said to be increased.

By the use of the "shot-weld" process of stainless-steel construction, each car will be made virtually a one-piece unit.

With the exterior streamlined in the modern mode, the interior will offer a new standard of comfort and convenience. There will be sleeping cars with berths, bedrooms, drawing rooms and compartments, dining car, cocktail lounge and club car, and, due to the new method of construction, these will be of wider inside dimensions than present standard railroad cars.

The new train, which will be drawn by a Diesel-electric locomotive, will cover the 2,225 miles between Chicago and Los Angeles in 39 hours, 45 minutes, compared with the present schedule of 53 hours, 45 minutes for the *Chief*.

Decision to build the 8-car train was reached by the Santa Fe after exhaustive tests with a light-weight, stainless steel coach built by the Budd company and described in the February issue of *The Welding Engineer*.

Reinforcing and Reconstructing Bridges and Other STEEL STRUCTURES by WELDING

By GEORGE J. DRIVER
Morrison Metalweld Process, Inc.

THERE can be no question as to the economies or merits in the use of welding for reinforcement, reconstruction and repairing of bridges and other steel structures. Any original steel or iron member involved in a structure, when inadequate, due to corrosion, defective material or excessive stress, can be reinforced or reconstructed by welding. New material can be attached to original members, keeping them intact as designed.

Increased loads and greater strength can be developed and, above all, this can be accomplished without the weakening or removal of any of the original structure. By sealing joints and points of contact, corrosion between metallic surfaces (one of the causes of deterioration) can be eliminated.

However, before welding can take its place in the sun, much preliminary work must be done to assure uniformly satisfactory results.

It is imperative that plans for proposed welding work be complete in every detail; that uniform and definite procedure for qualification of welding contractors, welding operators, and welding inspectors be established.

Uniformity of plans and specifications for proposed work has made great strides during the past few years—thanks to the American Welding Society—but there is still much to be done.

Contractor Should Pass Qualifying Test

The contractor should be required to pass qualifying tests before submitting figures on jobs. These qualifications should comprise experience and facilities. The facilities should include not only plant and equipment, but also technical knowledge.

Welders should undergo a standard, approved test of their ability to perform in three positions—flat, vertical, and overhead—as well as to work with shielded arc and bare rod. It is safe to say that inexperienced welders — and their resultant poor work—have been responsible for much of the condemnation laid against welding.

The inspector should be not only a qualified welder, but also an experienced bridge man. Lack of experience on the part of an inspector is known to result in friction with the workmen, and in inferior work.

The American Welding Society is in a position to take the lead in setting up standard tests by incorporation of a committee comprising the contractors and railroad and state engineers to formulate plans.

The following facts and suggestions have been formulated from experience gained after performing many different kinds of jobs in connection with repairing, reconstructing and reinforcing bridges and other types of steel structures.

Welding Has Wide Application on Steel Structures

Column bases have been reconditioned or reinforced without expensive falsework. New base plates, stiffener plates, webs, fins and anchor bolts have been welded to a rigid unit and all joints completely sealed, thus eliminating corrosion to a marked degree and adding considerable strength to the structure.

The sectional areas of columns and posts have been increased by adding cover plates or replacing latticing with cover plates.

Frequently web plates of end posts are corroded. The affected areas have been repaired by welding plates over them. Application of continuous fillet beads on these plates have added to the life of the structure by excluding moisture between metallic surfaces.

Proper welding methods do not involve the temporary weakening of members, which happens when riveting is used. Also, costs are kept to the minimum, because none of the original structure need be removed.

Flange sections, as in stringers and crossbeams, have been increased by welding cover plates to top and bottom flanges, the top plates being usually narrower and the bottom plates wider, thus permitting flat-position continuous fillet-welding, which is desirable.

Frequently the top flanges are corroded so badly that a narrow top cover plate cannot be designed that will provide for flat-position welding. This is remedied by trimming the corroded flange edges with a cutting flame, to secure a thick edge to apply overhead intermittent fillet-welding to a wider cover plate than the width of the top flanges.

Execution of either design will exclude moisture between metallic surfaces and permit repairing and strengthening of these members with no part of the original structure disturbed.

All riveted parts of girders can be strengthened by fillet-welding the edges to their parent member. Additional stiffeners for a redesigned girder have been applied by welding very satisfactorily. Top and bottom cover plates have been added by having plates punched for rivet-head clearances. When cover plates are applied, these holes are sealed by welding around the rivet heads.

Where permissible, flat fillet-welding should be used, particularly to sides of new cover plates. For reinforcing flanges, the application of angles welded longitudinally to the sides of the top cover plates, and plates or bars welded edgewise to each side of the web, longitudinally and above the legs of the lower flange angles, have been very successful.

Flange angles or any other angles that are overstressed, as well as those that are cracked, can be restored to original or better usefulness by proper reinforcement and by welding, properly planned and executed.

Welding More Efficient and Less Costly Than Riveting

Original members in a bridge structure that have become inadequate (due to corrosion, defective material, or excessive stresses) have been reconditioned or reinforced by welding with better results and greater economy than by the riveting method. In most cases traffic has been maintained while the work was in progress. A marked advantage is the feasibility of attaching new material to original members while keeping them intact as designed.

In a great many instances the reconstruction or reinforcement of a bridge on a railroad by riveting would necessitate the killing of two or three parallel tracks. By the welding method,

which eliminates the rivet-driver on one side and the bucker on the other, the actual operation is confined to a small area, and there is a large saving over the work involved in accommodating workmen on two sides of a job done by riveting. Also, in this connection, it is not necessary to remove a large number of rivets in order to apply new or added members, since in a great many cases this is accomplished by welding in a new member, removing only a small portion of the rivets involved.

Cutting out sections and installing new ones can be done with a very small proportionate amount of work, if properly planned and executed.

Four Outstanding Advantages of Welding

The outstanding advantages ascribed to the use of welding, versus riveting, in the repairing, reconstruction or reinforcing of bridges and structures are:

(1) Saving of time to plan the work, get the material and do the job.

(2) Saving of material, due to utilizing large portions of original members, it being necessary to remove only the defective parts, leaving the sound portions intact.

(3) Saving of man-hours, because one welding operator in a majority of cases can accomplish the same results in securing work in place as a two- or three-man riveting crew.

(4) Saving of both time and material, due to accessibility in the use of an arc or torch, as against the necessity of opening up both sides of a structure to remove rivets, fit up and redrive. In a great many instances the removing of old members by cutting out rivets would involve the complete abandonment of use of the structure, whereas by use of the torch and the arc the required repairs or replacement can be accomplished in a few hours, and no detrimental weakening of the structure is occasioned.

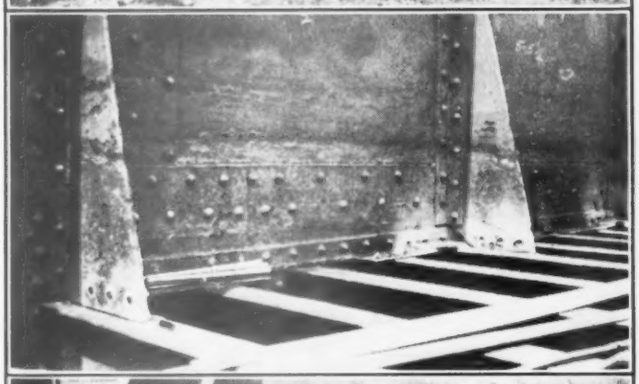
In a great many instances we have restored corroded areas to full sectional strength by building up with deposits of new metal. If these deposits are carefully applied (being certain to incorporate them with the sound portion of the affected member) the original strength is restored.

Local Treatment May Save Structural Members

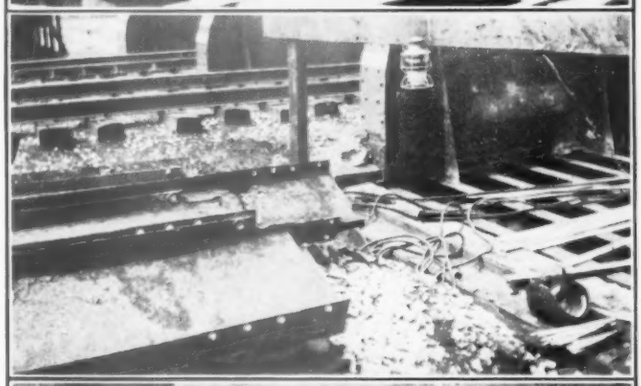
In such cases there is certainly a condition which causes corrosion throughout a definite area. It is possible to immunize this area against certain, corrosive destruction by applying a rust-resistant metal. This procedure results in the preservation of a large and expensive member by the proper treatment of a comparatively small area.

On one job that comes to mind the

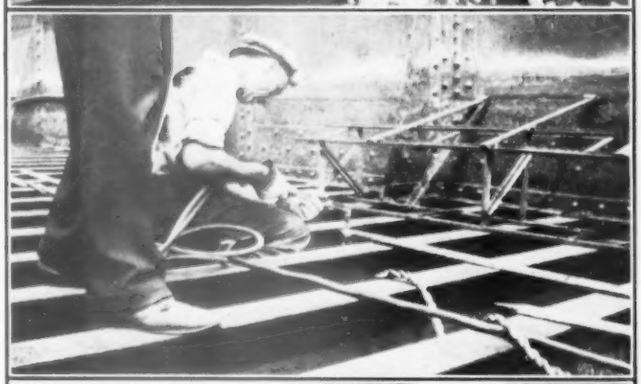
REPAIR welding a railroad bridge. Corroded areas must be reinforced and beams replaced. By using welding, only one side of the bridge need be closed to traffic at one time. Note the corroded ends of the beams at the left, which have been removed from the bridge.



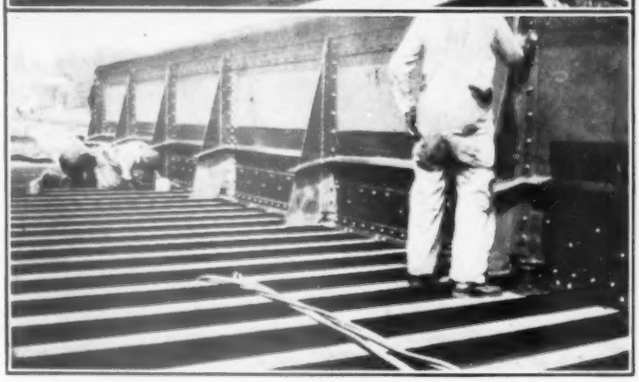
CORROSION occurs along a line marking the height of the ballast on the girder. This area must be reinforced and the angular plates replaced.



THE ends of the beams are badly corroded, and the web of one is entirely eaten through in one place.



BUILDING a framework over the repaired section, to be covered with tongue-and-grooved oak, creosoted and caulked with oakum to make a water-tight box. This keeps the ballast away from the girder and allows inspection from underneath.



GIRDER repaired and water table welded in place, before construction of the oak boxes.

web plates of the girders of a railroad bridge were corroded throughout the entire length of the span, along an area near the top edges of the ballast. These plates were corroded to such extent that in some spots there was hardly any metal left. Plates 12 in. wide and ½ in. thick were placed over the corroded areas so as to provide for welding entirely around their edges, securing them to the full sectional area above and below the corroded area.

These plates were also stitch-welded by burning slots 6 in. along at 12-in. intervals, 3 in. below the top and 3 in. above their bottom edges. Welds were then applied through these slots (obtaining fusion to the girder plates), and the slots were filled. This provided ample reinforcement, and in fact restored these girder web plates to better-than-original strength. The stiffener webs and joint plates were restored to their original dimensions by applying deposits over the thin, corroded areas, as previously described.

Welds Subject to Shearing Should Be Reinforced

It was brought to my attention by one bridge engineer for a large railroad system that some welding operations were not considered sound practice as far as he was concerned. He referred to butt welds, generally, and in some instances to lap welds. His contention was that plates or bars welded together should be reinforced by adding reinforcing bar or plate, lapping the welded area, the added piece to be welded properly in place to insure positive, ample resistance to shearing stresses. His contention was sound—as no matter how strong a weld may test by pulling (to prove tensile strength), that same weld may not withstand the shearing stresses under actual service in a bridge structure.

One subject to which I believe organized effort should be directed, for the purpose of eliminating friction and misunderstanding, is the changing over from structural ironworkers to welding operators. In territories where structural ironworkers have jurisdiction and insist upon employment of their members only, and rightly so, it becomes a difficult problem when the demand for welders cannot be met, due to lack of competent operators.

Need for Trained Structural Ironworkers

Any plan by which structural ironworkers can be properly taught the art of welding, so they can qualify, will be a boon to the industry. Of course this has been accomplished to a certain extent, but there are still large numbers of men who have not been reached and it would be a good investment to open the way to these and make it possible for them to become qualified welding operators at as little expense as possible.

I believe also it would be very much to the advantage of the organization to arrange for apprenticeships and set up a required test to be passed by all members who wanted to hold cards entitling them to take jobs as welders.

Certain structural ironworkers, few but influential, probably have, right up to this moment, considered welding as something disturbing the serenity of their trade, and therefore to be discouraged. These men should be reached in some appropriate manner and convinced of the advisability of their acceptance of welding as a modern development which they should welcome as a stimulus, rather than a deterent, to the advancement and broadening of the scope and efficiency of their trade. The sooner all structural ironworkers become competent welders, the sooner will welding reach the ultimate goal whereby all work that should be done by welding will be done by welding.

Skepticism on the part of some engineers, fearing internal stresses set up in original members due to welding reinforcing plates to them in various positions, has led to rather exhaustive tests to prove (or shall I say ascertain?) the extent to which such stresses affect the strength of such members.

Electrodes Must Be Selected for the Specific Job

It is through such tests as these that it is possible to ascertain the deficiencies caused by the use of improper electrodes and erroneous welding procedures. The main point is, however, that disclosures point to the fact that desired results can be obtained by the proper selection of types of electrodes for various purposes, the proper method of applying added members and the correct methods of utilizing the arc and torch.

Therefore, there is no cause for skepticism nor anxiety so long as the job of welding and engineering is in the hands of experienced, reliable supervisors and operators. This same state of affairs predominated at the inception of carpentry and riveted steel construction. Progress, due to research, tests and correction of errors, has always resulted in ultimate success, thereby bringing about economies and savings by which capital investment is minimized.

Another point I wish to make is that the real economy in bridge repairs, reinforcing and reconstruction is being overlooked to a large extent, and work that is being deferred would be done if the full confidence of officials could be obtained, especially throughout the Central West territory. The sooner it can be brought to their attention forcibly, by actual accomplishment of outstanding monetary saving, the sooner will welding be utilized on a larger scale to the mutual benefit of the welding industry and the bridge owners.

Foresee New Developments in Welding and in Design

Robert E. Kinkead, consulting welding engineer, and Dr. Antonio Longoria, consulting electrical engineer, both of Cleveland, O., were the principal speakers at the last of the monthly Spring meetings of the Pittsburgh Section of the American Welding Society, April 15, in the Blue Room of the Hotel William Penn at Pittsburgh.

It was a joint meeting with the Mechanical Section of the Engineers' Society of Western Pennsylvania and the Pittsburgh Section of the American Society of Mechanical Engineers, and nearly two hundred industrial engineers were present. The meeting was in charge of E. J. W. Egger, chairman of the Pittsburgh Section of the American Welding Society, and Joseph F. Minnotte, secretary.

Mr. Kinkead pointed out that original conceptions of welding were that it was a method of repairing something or a means of manufacturing an assembly of metal parts into some useful product. Mr. Kinkead is consulting welding engineer for the Carnegie-Illinois Steel Corp. and the United Engineering & Foundry Co.

However, he said, the latest conception of welding is that of building a continuous metal structure "in which the metal at any location is of such physical properties as to just meet the service requirement at that point." He predicted that the newer conception is likely to make the steel mills "spend the next thirty years trying to keep from making steel uniform." There were sound reasons why steel should not be uniform in chemical analyses or physical properties, and Mr. Kinkead predicted that "it is quite likely that steel pipe will presently be offered for sale, at competitive prices, which is different inside and outside."

Dr. Antonio Longoria, an M.D. who deserted the field of medicine for electricity, is a consulting engineer of international prominence. In addition to his work for the General Electric Co. and other corporations, as well as the motion-picture industry, he also serves in an advisory capacity for the American and British navies.

Unfortunately, some of the attorneys for various interests, which he represents, would not permit Dr. Longoria to tell the details of his recent electrical developments in welding, but he amazed the assembled audience by various samples of welded copper and other metals which he accomplished by secret processes that do not leave a stain or dis-

coloring. Of especial interest was the perfect welding of copper mesh screens in which no indication of welding was visible to the naked eye or the microscope. One sample of welded copper had a chemical composition, which he gave as 96% copper, 3% tungsten and 1% manganese. These samples could be bent in any way, shape or form, without harm.

Although Dr. Longoria "talked in riddles," as it were, to the delight of his hearers, who later pummeled him with questions, it was evident to his audience that he had left the beaten paths and started a new development in research, which should soon be available to the world, and one which, if followed, will no doubt obsolete many present methods and much of the equipment now in use.

He said that the molecular arrangement of all metals depends on temperatures and that the molecular structure varies with each degree of temperature as the heat is increased. This theory, he said, was brought out somewhat in detail by the editor of *The Welding Engineer* in an interview with him, concerning his work, which appeared in the March issue.

Dr. Longoria got into welding research purely by accident, when in 1920 he was called into consultation by the Goodyear Tire & Rubber Co., at Akron, O., to help solve the welding of 5/8-in. cable on the beads of tires. He eventually had to build his own transformer to accomplish this result for his client.

He cited many other interesting experiences, particularly with reference to his work for the motion picture industry, in California, and told of the many difficulties that confronted the industry when the "talkies" were first introduced.

By his new process, Dr. Longoria said that any metal can be welded, including aluminum.

When querried by the Pittsburgh correspondent for *The Welding Engineer*, Dr. Longoria said that the new methods, when adopted, will effect considerable savings in costs. They can be applied to any type of welding, including work of such magnitude as that which transpires daily in the large boatyards of the Pittsburgh district.

He said new standards for testing strength of materials were badly needed. In his own work, he always makes ten tests in each experiment, and then takes the mean average for his calculations.

Dr. Longoria was most generous with various samples of welds made by his method, and these he exhibited at the meeting.

Get "H. O. T." on Welding

By H. O. T. RIDLON

Spring

It's time for sulphur and molasses—at least a good many of us insist upon our kids taking it or some other distasteful spring tonic. I wonder if, after such a long, hard winter and several years of striving to keep ourselves together, a good tonic like sulphur and molasses wouldn't help the welding shop and shop owner, and possibly the welding industry as a whole—because business is done on enthusiasm, hope, ambition and good will—when you suppress men you destroy their freedom and initiative and kill business. The esteemed Charlie Schwab once said "Ruts often deepen into graves." I have many times in visiting welding shops keenly felt that suppression, and the rut the shop owner was in, that was gradually deepening into his own grave—unkempt, disorderly slipshod methods of that business—the entire thing was unsafe and tumbling in about me—tragic without hope, a complete picture of dismal despair.

We have an industry that is chockfull of hope and ambition and a future for all those in it. There is a great opportunity for profits and happiness, if you really love your work. To really succeed you must love your work with a great consuming enthusiasm — much like Louis Pasteur did. If you haven't seen that picture "Life of Louis Pasteur" you should by all means see it. It is a great story, wonderfully told. Of course it was close to me because the wife of one of my best friends is Louis Pasteur's granddaughter, and my father remembers him well in the early days of medicine. When I saw that picture, and for many days afterwards, I could not help but feel what strides this industry of ours would make if there were but one man in it who had the same spirit of accomplishment for welding that Louis Pasteur had for science that helped medicine and all of us to live today. I feel that the future of the welding industry is just as important to civilization today as the work that Louis Pasteur did in his day—and this goes for the highest in our engineering skill, right on down the ladder to the lowliest cub, or student in the industry. I fear that too many of us do not think of tomorrow, or five or ten years from now, as we should—that we take our work too much for granted—there is no real dynamic power of purpose behind us. I realize that all of us come to the end of our rope at times. When that happens, there is only one thing to do—tie a knot in it and hang on. Let's all of us take a Spring tonic and try to do a better job for welding.

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Mixing Gas With Water

An interesting report came to me after this hard winter, during which many shop owners cashed in on it by the thawing of pipes. Of course, I cannot vouch for this story, except that it was told to me by Charlie Lill, of Pittsburgh, and I am passing it on now, because I think that each shop owner and welder should file it away in the back of his head for future reference. It seems that a local customer's pipe line froze up, so he hollered for help from Joe Welding Shop Owner, who rushed out and hooked up his terminals and turned on the juice. The pipe thawed out OK and Joe Shop Owner went on his way rejoicing at the nice profit he had made. But Mr. Customer went upstairs to turn on his water in the bath room, and gas came out of the faucet; he went down in the basement to light the hot-water heater, and water came out of the gas line. What happened was, that the water and gas lines some place were very close together and arced across and burned a hole in each other, which caused this tragic effect,—which takes us back to my often repeated sermon "know what you are doing before doing it, or don't do it"—because it is not only lost profits but time wasted as well, which time could have been devoted to other profits. Study, inquire, and know what you are about before tackling any job, particularly with other people's property. I strongly suspect that this experience won't help that particular shop owner to sell this method of thawing pipes.

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Hard-Facing on the Highways

Months ago I predicted that there was going to be a lot of road work this spring and summer, which is certainly the case in the sections of the country that had a real heavy winter. Of course, you gents who live in the southland or out in the country of perfect climate, aren't interested in what I am saying—but the roads are a good deal worse than anybody could possibly have predicted and every county and state highway department has more than they can do. This is certainly a golden opportunity to get out and sell hard-surfacing to county and state highway departments and road contractors. It should be a harvest to welding shops who will go out and sell them the benefits of hard surfacing.

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Don't forget to organize your H. O. T. for President Club—more next month on this timely subject. A welder for President will weld business and government together with confidence.

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Thought for the month: Some people never learn anything—they understand everything too soon.

Welding Units Do Yeoman Service in Hartford Flood

Manufacturers of arc welders are pointing with pride to service performed during the floods in Hartford, Conn., by portable welding units, which were called upon not only for welding services of many varieties, but also for many jobs which the average welder would hardly consider part of his duties.

When the floods struck Hartford, portable welders were pressed into extraordinary service at once, and other units were rushed to the stricken community, and as fast as they arrived they were pressed into duty, operating every minute, day and night, some of them for five days without stopping.

When the waters had subsided enough to permit townspeople to look about and get a general idea of what had happened, it was found that without these units on the scene Hartford would have been in a bad way indeed.

When the Hartford radio police communication system went out of service, an adjustment was made to the gas-engine governor on a welding unit to give the right alternating-current frequency and the communication system was put back into service once more.

Water burst in torrents into the telephone building's power rooms. Power supply from the outside went dead. All that remained to furnish power were the giant emergency storage batteries, and soon they were swallowed up by the onslaught of water. Quick thinking on the part of the telephone-plant enginers resulted in bringing in two gasoline-engine-driven d.c. welding generators.

Lights were furnished for a hospital from a welding unit, which also operated such motors as were needed in service. By putting two units in series it was possible to light 400 50-watt electric lights 24 hours a day.

General pneumatic wrecking and rehabilitation construction were carried on by means of air compressors, which also rendered important services in opening emergency outlets for the water to run off.

Cellars and basements of many important buildings were drained by pumps coupled directly to the shafts of welding units.

Launches 258-Ft. All-Welded Tanker

Over 25 miles of welding was used in the construction of the *Transoil,* an all-welded steel tanker, built for the American Tankers Corp. and launched on Jan. 29 at the Chickasaw plant of The Ingalls Iron Works Co. at Mobile, Ala. In certain dimensions, this ship sets a new mark for all-welded vessels. A comparison between it and the all-welded tanker *Moira,* launched on Apr. 30, 1935, from the Wallsend Shipyard of Messrs. Swan, Hunter & Wigham Richardson, Ltd., and at that time the largest all-welded vessel, is of interest:

	Transoil	Moira
Length between perpendiculars	251 ft. 3 in.	245 ft.
Length overall	258 ft. 0 in.	257 ft.
Breadth, molded	43 ft. 0 in.	42 ft.
Depth, molded	16 ft. 8 in.	18 ft.

The same English firm that built the *Moira* has received an order from Canadian interests for an all-welded vessel for service on the Great Lakes and Gulf of St. Lawrence, that slightly exceeds in dimensions the *Moira* and *Transoil.* This one will be 259 ft. long overall, with a breadth (molded) of 43 ft. 10 in., and a depth (molded) of 22 ft. This vessel presumably is to replace the *Joseph Medill,* which disappeared in mid-Atlantic on its maiden voyage last fall.

The oil tanker *Transoil* was designed by George B. Drake, naval architect, and is constructed with the Isherwood Bracketless system of longitudinal framing in the parallel midship section and with transverse framing in the molded bow and stern.

The hull is subdivided by nine oil-tight and water-tight transverse bulkheads and by two oil-tight longitudinal bulkheads to provide a fore-peak, forward reserve tank, four sets of main cargo tanks, cofferdam, machinery space, cross fuel bunker, and after-peak. Further subdivision is made with steel oil-tight and water-tight bulkheads for a pump room on the starboard side of the machinery space and a reserve fuel tank on the port side. The space under the raised deck aft is divided by steel and wood bulkheads to provide quarters for the crew, galley, mess room, etc.

Pittsburgh Flood Aids Market For Welding Equipment

By EDWARD H. SYKES
Pittsburgh Correspondent
The Welding Engineer

The great St. Patrick's Day flood wrought considerable havoc with many of the large industrial plants in the Pittsburgh area which are accustomed to handling welded construction of huge proportions. While temporarily crippling many of these industrial giants, the flood, at the same time, destroyed the properties of many other companies, including a number of refineries, which are now coming into the market for welded tanks and other equipment.

The net result of this catastrophe, estimated to have caused damage in the Pittsburgh area, alone, of a quarter of a billion dollars, is that more equipment will now have to be purchased and greater employment will ensue, in order to repair the ravages of the swollen streams.

Some idea of the vast extent of this terrible disaster may be gained from the fact that the "Golden Triangle" in Pittsburgh was completely inundated from Smithfield Street, west to the Point, where the Allegheny and Monongahela rivers meet to form the Ohio. In lower Penn Avenue, Pittsburgh, near the historic block-house, the flood waters reached a depth of 17 ft. The water extended clear up Liberty Avenue to the Pennsylvania Railroad station.

While the mercantile business interests in downtown Pittsburgh were unusually hard hit, the large industrial plants, situated along the rivers, for the most part, were badly inundated. While it is not possible to mention all these companies, those known to have suffered heavy damages included the majority of the large welding fabricators, among them, the American Bridge Co., the Jones & Laughlin Steel Corp., various United States Steel Corp. subsidiaries, Bethlehem Steel Co., Dravo Contracting Co., Westinghouse Electric & Manufacturing Co., Treadwell Construction Co., at Midland, Pa., and many others in northern West Virginia and eastern Ohio.

The remarkable thing, however, is that all these companies jumped right in with their reconstruction programs and all the shops are now operating again, although in a limited way. It would be difficult to estimate, accurately, the amount of damage inflicted by this momentous catastrophe but industrially, the loss will be tremendous.

One of the hardest-hit plants was that of the Waverly Oil Works at Pittsburgh. This company saw about 50 of its oil tanks floated away and in the midst of the trouble, fire broke out, adding oil to the troubled waters. All of the time this was going on, Pittsburgh was without light or power, water and telephone services.

The Republic Oil Co. and the Canfield Oil Co., both at Coraopolis, Pa., on the Ohio River, below Pittsburgh, were also badly hit by the flood. Even the refineries at Oil City and along the upper Allegheny River, were hard hit and as the flood raged, tank after tank was seen floating down the Ohio River.

At Pittsburgh, the rivers reached a crest of 46 ft., which is 21 ft. above the normal flood level. It is believed that the 48-hour rain, which precipitated the flood waters, was unable to penetrate the ground, which had been frozen to great depths, due to the severity of the winter, and as a result the water rushed over the surface of the earth like water off a duck's back.

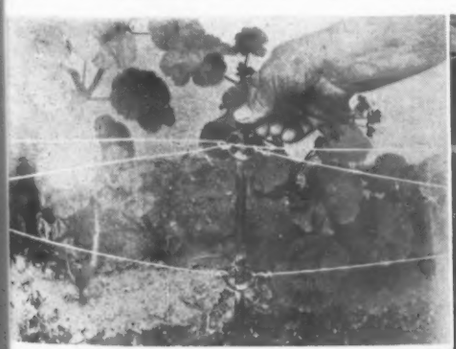
It is altogether probable that steps will be taken immediately by the Federal Government to prevent the recurrence of such a major catastrophe, by the construction of a series of flood reservoirs.

Welding News in Pictures

• A 400-ampere arc welder and oxyacetylene welding and cutting equipment in the tonneau of a 1929 Master Buick sedan, used by the Faribault Machine Shop & Foundry, Faribault, Minn., in field work. Generator driven from car motor through six V-belts.

• A 500-ton steel press brake, capable of bending materials 16 ft. long, manufactured by the Boom Boiler & Welding Co., Cleveland, O. Made entirely of arc-welded steel; not a single casting used. Welded construction permitted 30 days' saving in time and $2,200 in cost through elimination of patterns and pattern drawings. Saving of $1,500 effected in machining costs alone. (Photograph courtesy of The Lincoln Electric Co.)

• (Below) Loving cup built free-hand with 1/16-in. bronze welding rod, by R. W. Merrifield, Garden City, Mo., who started by building a ring on the welding table and continuing layer on layer to complete the cup. The handles were formed in the same way. It was then polished and lacquered, giving a gold appearance. The cup is about 8 in. high, with a wall thickness of about 3/32 in., weighs about 3 lb., and is water-tight.



• A useful garden stake made from 1-in. tubing, sharpened at one end, with small metal rings welded to it.

• Cast-iron bed plates serve as foundations for precision welding operations in plant of Electro-Motive Corp. at La Grange, Ill.

Views of New Plant of Harris Calorific Company, Including "Steamer Deck" on Top Floor.

Harris Calorific Company Established in New Quarters

In a new, modern plant, in a picturesque setting, the Harris Calorific Co., of Cleveland, are continuing operations in the manufacture and sale of their welding equipment and accessories. The new plant is in the northwestern part of the city, on Cass Avenue, and overlooks Edgewater Park and the Cleveland harbor. It is of one and two story construction, with office and plant equipment and layout in keeping with modern ideas of arrangement. The grounds are beautifully landscaped.

A novel feature of the new plant is the use to which the roof has been put. This is laid out in imitation of a ship's deck, with steamer chairs, funnel ventilator, ship's bridge, and everything necessary to add realism to the general plan. On the ship's bridge is mounted the steering wheel from the ill-fated *Morro Castle*. The illustrations on this page show the plant and the "steamer deck."

Tennessee Holds Welding Conference

The welding conference held at the University of Tennessee on April 14 to 17 was well attended, and high interest was shown in the papers presented and the demonstrations. The following papers, talks, and motion pictures were included in the program:

Welcome Address, by C. E. Ferris, Dean of Engineering, University of Tennessee.

"Oxyacetylene Welding in Industry Today," by I. F. Fausek, vice-president, Modern Engineering Co., St. Louis, Mo.

"Arc Welding in Industry Today," by R. H. Jackson, welding specialist, General Electric Co., Atlanta, Ga.

"Welding of Heavy Castings," by R. W. Chambers, designing engineer in charge of welding, Dam Division, T. V. A., formerly chief engineer, General Steel Castings Co., Philadelphia.

"Stainless Steel in Industry Today," with sound movie, by Mr. Lichtenwalter, Republic Steel Co., Cleveland, O.

"Carbide in Industry Today," by W. F. Kuhl, district manager, Shawinigan Products Corp., New York, N. Y.

"Stresses and Strains Encountered in Welding," by H. E. Hicks, chief engineer, Modern Engineering Co., St. Louis, Mo.

Sound movie on arc welding, by the General Electric Co.

Sound movie, "The Profits of Progress."

Movie on pipe welding.

"Welding of Mechanical Equipment," by John P. Ferris, chief of Research Section of the Agriculture and Industries Division, T. V. A.

"Economy and Quality in Welding Through Personnel Training," by L. C. Monroe, advertising manager *The Welding Engineer*, Chicago.

Movie, "Prosperity Process."

"Manufacture and Welding of Manganese Steel," by B. H. Payne, general manager, Standard Sickles Co., Newark, N. J.

"Gas Welding and Brazing Cast Iron," by Roy Peterson, Emporia, Kan.

Part of the equipment fleet operated by Massachusetts Welding Company, and (insert) the genial and dynamic Frank O'Rourke, who started the business and manages it today.

From the largest welding shop in Massachusetts . . .

praise for TOBIN BRONZE

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Automobile Bodies, Radiators, Fenders, and Tanks Repaired — Contractors' Equipment and Machinery Repairs — Brazing and Cutting

Electric and Acetylene Welding

79 CLAPP STREET, CORNER MASSACHUSETTS AVENUE

BOSTON, MASS.

Radiators Re-Cored and Repaired — Ship Work and Marine Boilers — Specialists in Thawing Frozen Water Lines

March 26, 1935.

The American Brass Company
Waterbury
Connecticut.

Gentlemen:

During the past 15 years, our welding business has increased tremendously. We attribute our growth to these three facts: (1) Our workmen are trained to produce A-1 work. (2) We use only the best grade of stock. (3) Our prices are fair.

The use of good stock is one of our fundamental policies. Good stock builds Good Will for our shop. Therefore we recommend genuine Tobin Bronze and use it exclusively as we have since our business was started 15 years ago.

Very truly yours,
MASSACHUSETTS WELDING CO.
Frank O'Rourke

From a two-man shop operating one truck to the largest business of its kind in the state of Massachusetts . . . in the short space of fifteen years! That is the achievement of the Massachusetts Welding Company of Boston under the management of Mr. Frank O'Rourke.

During his years in the welding business, Mr. O'Rourke has always used good stock . . . Tobin Bronze. Read his letter, reproduced here. It tells you what he thinks of the original low melting point bronze rod.

Don't gamble with an unproved rod. Ask for and get *genuine* TOBIN BRONZE. It carries the name stamped every 12 inches in each rod.

ANACONDA
from mine to consumer

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD.
New Toronto, Ont.

ANACONDA WELDING RODS

What's New in Equipment and Supplies

Torchweld Announces Low-Priced Units

A low-priced welding unit, known as Type 5SL, has been announced by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill. In addition to the torch, this unit contains four tips, each with two 2-in. 2-gauge regulators, two lengths of ¼-in. hose, and other equipment to make the unit complete, ready to be attached to the tanks. The tip sizes are Nos. 2, 4, 6 and 8, though the torch will take up to a No. 12 tip.

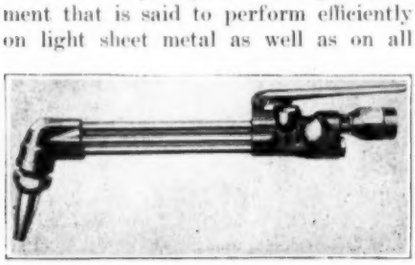
Corresponding cutting units also have been announced by Torchweld, these being Types 26SL and 16SL, the former having a 2-piece tip and the latter a 1-piece tip.

Coated Electrode for Transformer-Type Welders

A new electrode for which high arc stability is claimed, has been developed for use with small-capacity a.c. transformer welders, by the Steel Sales Corp. of Chicago, Detroit and St. Louis. This electrode is of the coated type and is designated as the "AC-Weld Electrode." It is also said to facilitate the striking of the arc. Tests of weld metal produced by this electrode reveal ultimate strengths of 56,000 to 67,000 lb. per sq. in.; and elongation in 2 in. of 15% to 25%. This electrode is also said to perform satisfactorily with d.c. welding units. It is available in four sizes: 3/32, ⅛, 5/32 and 3/16 in.

Cutting Attachment for Wide Range of Work

A new oxyacetylene cutting attachment that is said to perform efficiently on light sheet metal as well as on all but the heaviest work, has been announced by The Linde Air Products Co., 30 East 42nd St., New York, N. Y. This attachment, known as the Oxweld Type CW-22, can be used on either the Oxweld Type W-17 or W-22 welding blowpipe handle. It operates on low-pressure or medium-pressure acetylene. Exceptional flashback resistance is said to result from the length of passage and four 90° changes of direction.



Cutting Attachment of Injector Type.

Cartridge Respirator Gives Protection Against Fumes

For protection against organic fumes, the No. R-150 chemical-cartridge respirator has been announced by the Pulmosan Safety Equipment Co., 178 Johnson St., New York, N. Y. This respirator gives protection while spraying paint, and also guards against low concentrations of sulphur dioxide and against smoke. The chemical cartridge purifies all incoming air. This respirator can be worn with goggles. A flutter type of exhalation valve permits natural, easy breathing and will not clog or leak.

Light Electric Hoists for Spotting Work

An entirely new line of light electric hoists, called "Zip-Lifts," with capacity ratings from 250 to 500 lb., is announced by the Harnischfeger Corp. of Milwaukee. Designed for "spot handling" work in machine shops, welderies, foundries, etc., these units are of all-welded construction, the quarter-ton model weighing only 100 lb. The "Zip-Lifts" have hoisting speeds up to 32 ft. per minute, and are controlled either by push button or pendant rope. Weight-type limit switch, solenoid dry-disc motor brake and ratchet and roller-type mechanical brakes insure safety. Standard units are furnished with or without trolley.

"Zip-Lift" for Spot Handling Work.

Trade Literature

Electrodes and dies for resistance-welding applications, are described in two bulletins recently issued by the Electroloy Co., Inc., 50 Church St., New York, N. Y., which pertain to the Grade B and the Grade XX alloys. Physical properties are listed, and details of application shown.

"Safe Steels for Sub-Zero Service" is the subject of a pamphlet issued by The International Nickel Co., Inc., 67 Wall St., New York, N. Y., dealing with applications of nickel steels and the low-temperature properties of these steels and of stainless steels and high ferro-nickel alloys.

"Oxwelding Brass and Bronze" is the title of a pamphlet published by The Linde Air Products Co., 30 East 42nd St., New York, N. Y., giving information on welding procedure and metallurgy. A section is devoted to the welding of commercial yellow brass pipe.

Gas welding and brazing of high-nickel alloys, is the subject of a pamphlet published by The International Nickel Co., 67 Wall St., New York, N. Y., treating of welding, brazing and silver-soldering procedures, and applications of these alloys.

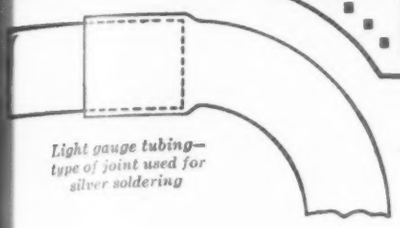
That welded steel jigs and fixtures lead to lower tooling costs, is the theme of a booklet recently released by The Lincoln Electric Co., Dept. CC-21, Cleveland, Ohio. Many types of welded fixtures are illustrated, and cost figures are given.

"Torchweld" welding and cutting equipment and accessories, including the new 5SL welding unit, are described and illustrated in catalog No. 36, now in course of publication by the Torchweld Equipment Co., 1035 W. Lake St., Chicago, Ill.

The "Zip-Lift," a low-capacity, low-priced electric hoist, is described in Bulletin H-1, issued by the Harnischfeger Corp., 4401 W. National Ave., Milwaukee, Wis. Features of construction are described and specifications are given.

THIMBLE SIZE JOB . . . OR JUMBO

There's ways to lick them both!



Light gauge tubing—type of joint used for silver soldering

NICK RODDER

IF THERE'S any time of year it's hard for a trout fisherman it's along about the last of March. You get sort of itchy all over like a new pair of wool underdrawers. And yet it aint a thing in the world but trout-itis, and it can be cured in a few hours by letting the patient wade around in cold water, which often works into a chill that it takes a pint and a half of schnapps to fix up.

Well I'm in the first stages of the disease, when the Boss sticks his head in the door.

"Nick," he says, "can you spare the time to go up into New England for a day or so and show them how we silver solder thin wall Monel Metal tubing?"

The customer had an order to make four fin-type heaters out of Monel Metal and the basis was ¾" O. D. Monel Metal tubing with .049" wall. There was 180° return bends used to join parallel tubes in the heater. This was done by belling the ends of the bends for about ½" so they slip over the normal end of the straight tube in a "light push" fit.

Before assembling I cleans the joint and paint on the recommended flux. Then we put the assembly together and heat with an oxy-acetylene flame, taking the precaution of using a small tip and keeping the flame moving. Just as soon as the flux shows signs of melting, the silver solder is touched to the edge of the joint.

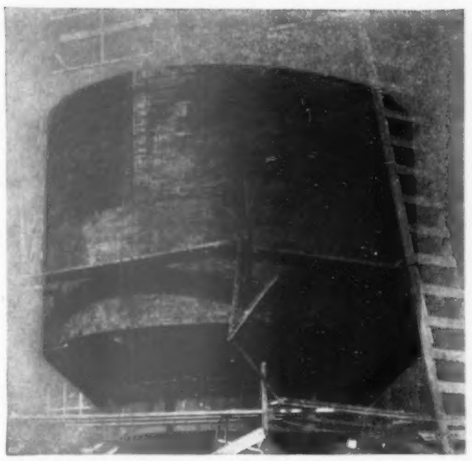
There's a couple of silver solders recommended, which flows at 1175°F and 1375°F—which is a low red heat. When those temperatures are reached, the solder flows freely and penetrates the full depth of the lapped area. That's what makes a good joint. The only point to be watched is not to apply more heat than is needed to flow the silver solder properly. Silver solders are fairly widely used with Monel Metal and Nickel because of their good resistance to many different kinds of corrosives.

A Little Job of Tank Building

Well I am hardly through this "thimble size" soldering job, when I get started off onto a tank building job that is about as different as sardines and whales.

The tank of which I'm telling you about is to be erected in position. She's Nickel-clad Steel and completely welded—no rivets—and about as pretty a picture as I could give you of welding in the down hand and vertical positions.

We first tack and then weld the steel side. Then we chip out the Nickel side of all the seams about 1/16" deep with a 3/16" round nose gouge. Next we take our No. 35 Nickel Metallic Arc Welding Wire—⅛" dia., and start welding the vertical seams from the bottom of the joints. By using high heat, short arc, reversed polarity and a slight weave you ought to see the nice neat flat joint that turns out.



● *Nickel-clad Steel caustic soda settling tank. Conical bottom and bottom course is ⅜"—next course is 5/16" and top of shell is ¼"—all 10% Nickel-clad.*

The roundabout horizontal seams are all welded the same way, and when the job is finished there isn't nothing on the inside, Nickel-clad side, of that tank save and except Nickel. Which is lucky, seeing as it's built for storing strong caustic.

* * *

When the Boss reads this he says, "Nick, why don't you tell those buddies of yours that we'd like to send them some good reading on welding, not to mention a handy shop card and other free printed items which can be had for the writing." If you want any of this material, some of which is quite valuable and might save you from a tight hole some day—just write to me care of the below address and I'll mail it to you.

Meantime, I'm hoping to see you soon.

Nick Rodder
INCO WELDING SERVICE

INCO WELDING RODS and FLUXES

for **PURE NICKEL**
Oxy-Acetylene . . . No. 41 Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 31.
Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

for **MONEL METAL**
Oxy-Acetylene . . . No. 40 Monel Gas Welding Wire. For flux see * below.
Oxy-Acetylene . . . No. 43 Silicon Monel Gas Welding Wire.
Metallic Arc . . . INCO Monel Metal Arc Welding Wire No. 130.
Carbon Arc . . . INCO Monel Carbon Arc Welding Wire No. 20.

for **INCONEL**
Oxy-Acetylene . . . No. 42 Inconel Gas Welding Wire. For flux see ** below.
Metallic Arc . . . Inconel Metallic Arc Welding Wire No. 32.

for **NICKEL-CLAD STEEL**
(for welding of Nickel side)
Oxy-Acetylene . . . No. 41 Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 35.
Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

FLUXES
* INCO Gas Welding and Brazing Flux for Monel Metal.
** "Cromalloy" Gas Welding Flux is recommended for Inconel.
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

INCO welding materials as listed can most conveniently be obtained through regular INCO distributors.
Detailed welding instructions furnished on request.

MONEL METAL

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

RYERSON

A Dependable Source for

WELDING ROD

Ryerson Engineers have developed a series of rods that are outstanding for quality production. They are continually checking, testing, and improving—to develop rods that will do specific types of work, faster and better.

Bring your welding rod problem to Ryerson. Let our engineers work with you. You can be sure of finding the right rod for each particular class of work. We will also gladly furnish samples for test. Address the nearest Ryerson plant.

23 Types of Rods in Stock

ELECTRODES

Ryerson Shielded Arc Type No. 215
Ryerson Shielded Arc Type No. 216
Ryerson Shielded Arc Type No. 217
Ryerson Green Processed No. 18
Ryerson Green Processed No. 6
Ryerson Bare Mild Steel
Ryerson Brown Processed
Ryerson White Flux Coated
Ryerson High Carbon White Flux Coated
Ryerson Blue Flux Coated
Ryerson 3½% Nickel Steel Flux Coated
Ryerson High Manganese Steel
Hyerson Hard Surfacing
Ryerson Allegheny Stainless Flux Coated
Ryerson Allegheny Stainless No. 44

GAS RODS

Ryerson Copper Coated No. 206
Ryerson Copper Coated No. 210
Ryerson Cast Iron
Ryerson 3½% Nickel Steel
Ryerson Tobin Bronze
Ryerson High Carbon Bare No. 2110
Ryerson Allegheny Stainless Bare
Ryerson Hard Filler

Write for Bulletin on Rods and Accessories

JOSEPH T. RYERSON & SON, Inc.

Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo Boston, Philadelphia, Jersey City.

Commercial News

Gulf States Reported as Adding Tin-Plate Mill

The position of Gulf States Steel Co., Birmingham, Ala., in relation to other steel producers has largely been dependent on the farming situation of the South, since its output has mostly been confined to wire and such wire products as fencing, nails, staples and bale ties, according to a report in a recent issue of *New York Daily Investment News*.

As long as the plight of the cotton farmer remains a political problem, the agricultural prosperity of the South is assured, the report points out. Gulf States is contemplating the addition of tin-plate equipment, according to current reports, which very likely will further strengthen their position, unless price cutting becomes an important factor that must be contended with. The company entered the welding-electrode field in 1931, and has enjoyed a growing business in this line of manufacture.

The Taylor-Winfield Corp., of Warren, Ohio, have purchased the equipment of what was formerly known as the Thomas Welding Laboratories, Inc., and have leased the building occupied by this firm, at 15120 Woodward Ave., Detroit, Mich. The plant will be operated as the Fabricating Division of the Taylor-Winfield Corp. J. D. Gordon, who was for ten years with the Extruded Metal Products Co., of Bridgeport, Ohio, is Detroit plant manager for the new owner.

The following distributors for Republic Steel Corp. products have been announced: Equitable Equipment Co., Inc., of New Orleans, will distribute "Enduro" stainless steel, and "Toncan Iron" sheet will be distributed by the York Corrugating Co., York, Pa., Sheet Metal Manufacturing Co., Inc., Stamford, Conn., and the Noland Co., Inc., of Washington, D. C.

Joseph F. Sweeney has been engaged by the Federated Metals Corp., 120 Broadway, New York, N. Y., to specialize in the purchase of scrap nickel, nickel alloys and nickel-bearing materials. Mr. Sweeney was formerly connected with the International Nickel Co., Allegheny Steel Co., Michiana Products Corp., H. Boker & Co., and Cosmo Metal Alloys Corp.

The firm of L. Hall & Co. has been formed and an office opened at 812 Washington Blvd. Building, Detroit, Mich., to act as Michigan distributors for an a.c. welder made by the Ohio Welder Co. at Middlefield, Ohio. Lewis L. Hall and William O. Grey are partners in the Michigan company.

F. A. Welch, Cleveland, Ohio, representative for the P&H-Hansen arc welder, has also added other Harnischfeger products to his line, including the P&H-Milwaukee line of electric hoists and I-beam electric cranes.

The British Oxygen Co., Ltd., have moved their head office to Thames House, Millbank, Westminster, S. W. 1, London, England, where they are now occupying the entire second floor.

The Puritan Compressed Gas Corp. is building an addition to its No. 2 plant in the Blue Valley industrial district in Kansas City, Mo.

Notes From the Field

A gas shovel used in excavating for new rackhouses at The Century Distilling Co., of Peoria, Ill., was repaired a short time ago by welding. The ears on the dipper stick that holds the stop were broken off, due to constant contact of the clutch against the boom. Seven storage tanks in the commercial alcohol unit of this plant have been completely overhauled by welding. New outlet fittings have been welded on in place of riveted ones, and these tanks have been patched by welding new steel sheets in them. In plant No. 5, gusset plates were welded to the driers, so the frame holding the shaft would be supported. All welding was done by The Superior Welding Co., 331 Knoxville, Peoria.

The erection of two welded tanks for the Sinclair Refining Co. at 1921 Harrison St., Kansas City, Mo., is under way by the Kansas City welding firm of Camp & Luthy, Inc. This firm is also engaged at present in building up sprockets and shovel dippers for the Funkhouser Equipment Co., and has just finished making a welded steel planer from mild steel. For the past

outh Camp & Luthy have had five en working on a conveyor at the ndahy Packing Co. plant, which job is nder Federal Government inspection.

The Standard Oil Co. of Louisiana reported to be in the market for two l tank barges for use on the Ohio and ississippi rivers between Louisville, y. and New Orleans. Prices on welded nd riveted construction are being asked, though it is believed that the company eans toward the former for it now op- ates a number of welded barges, and now has under construction four elded tank barges being built by the arietta Manufacturing Co., Point easant, W. Va. The new barges will e 175 ft. long, 35 ft. wide and 8 ft. eep, with a capacity of 6,000 barrels ch.

The Skelly Oil Co., Eldorado, Kan., e just getting under way on the con- ruction of a complete new cracking it which is said to be the very latest gasoline-refining equipment. A great mount of electric welding as well as s welding and cutting will be required. he Alcorn Combustion Co., Philadel- hia, Pa., have the contract for install- g the furnace in connection with the acking unit. Considerable welding will so be required on this unit. Comple- tion of the job will require from four to five months.

Owners of barges and boats operating on the Illinois river depend on welding for repairs. With traffic open on the river, there will soon be a considerable amount of this work being done in the vicinity of Peoria, Ill. Patches are now being welded on several barges of The Kingston Lake, Sand & Gravel Co., south of Mapleton, Ill., who are furnishing sand and gravel used in building the large dam at Whites Crossing, south of Peoria. Welding is being done by The Superior Welding Co., of Peoria.

A 50-ft.-diameter all-welded sphere is being completed by the Bethlehem Steel Co., Pittsburgh, Pa., for the Diamond Alkali Co. at Fairport Harbor, Ohio. The sphere will be used for the storage of coke-oven gas. The structural steel for this large gas holder was turned out at the Leetsdale Works of the Bethlehem Steel Co., near Pittsburgh. It was shipped "knocked down" and is being butt welded on the job, in accordance with the requirements for A. S. M. E. Code Class 2 welding.

An order for 8,000 tons of carbon-arc-welded pipe has been received by the Bethlehem Steel Co., of Pittsburgh, from the city of St. Louis, preliminary details of which were published in the March issue of *The Welding Engineer*. The work will be turned out at the Leetsdale, Pa., works and delivery will be made during the summer and fall months.

The Chicago Bridge & Iron Works, Chicago, Ill., has been awarded a contract by the Aetna Oil Service, Inc., of Louisville, Ky., to build a 40-ft.-diameter welded spherical gas holder for use at their Louisville refinery. This huge gas container is designed for a pressure of 15 lb. per sq. in., and with the foundations, etc. will cost approximately $10,000.

A contract for three welded steel fuel flats has been awarded by the Campbell Transportation Co., of Pittsburgh, Pa., to the Dravo Contracting Co., also of Pittsburgh. These coal barges will be 125 ft. long, 26 ft. wide and 8 ft. deep, and will have a capacity of 400 tons each. They will be fabricated on the marine ways of the Dravo company at Neville Island, a few miles below Pittsburgh, on the Ohio River.

Plans and specifications for three welded steel dump scows for the United States army engineers at Louisville, Ky., have been completed by the Pittsburgh office of the corps of engineers. These

PROTECT *your* WELDERS
AGAINST DANGEROUS FUMES!
Supply this respirator with their goggles!

ot only welders' eyes, but also their lungs need pro- ection when working in badly ventilated rooms—in onfined places such as tanks — or on any metals oated with paint or substances. These fumes are in- rious to health. Avoid all danger with the

R-150 CHEMICAL CARTRIDGE RESPIRATOR

hich purifies inhaled air. A special chemical cart- dge makes noxious fumes harmless. The R-150 is afe, comfortable, light weight, permits easy breath- g. Inexpensive. No hindrance to goggles or work- g efficiency. Thousands in use. Send order today, r write for further details.

PULMOSAN SAFETY EQUIPMENT CORP.

Dept. W. E., 176 Johnson St., Brooklyn, N. Y.

Also full line of

GOGGLES HELMETS
GLOVES ELECTRODE HOLDERS

Write for complete catalog.

scows will be 114 ft. long, 26 ft. wide and approximately 8 ft. deep, with a capacity of 280 cu. yd. They will be used on the Louisville and Portland canal, and bids for their construction will be asked soon.

The Cleveland School of Welding, Cleveland, Ohio, are rearranging their layout and making additions to equipment, to care for an increased number of students enrolled. Three more d.c. arc-welding units were recently added, making a total of eight now in use, and the number of oxyacetylene units has been increased to 42 by further additions. Also, two oxy-hydrogen welding units have been installed.

Two all-welded steel smokestacks, each 40 in. in diameter and 100 ft. high, were recently fabricated in the field by the Atlas Boiler & Welding Works, 205 S. Ninth St., Louisville, Ky., for the Dent & Head Distilling Co., at Gethsemane, Ky. The Atlas people have a contract for seven more smokestacks and for an all-welded steel water tower to be erected in Nelson County.

One of the largest inquiries for welded barges ever received by boat yards in the Pittsburgh district has just come from the Hatfield-Campbell Creek Coal Co., of Cincinnati, O., for 20 to 25 standard steel coal carriers. Based on standard barge design of 175 ft., each barge will require 150 tons of steel, or a total for the entire job of 3,000 to 3,750 tons.

A. Tuchin, featuring general job welding and auto-body work, recently opened for business at 4001 E. 9th St., Los Angeles, in the location formerly occupied by D. G. Green, recently killed in an automobile tragedy. The shop will be operated under the name of Abe's Welding & Body Works.

One of the old-timers in the welding business is A. M. McCutchan, of the McCutchan Welding Works, Lake Charles, La., who started welding 25 years ago, and has been in the business ever since.

On account of the recent Pittsburgh flood, work on the construction of the welded steel hull for the steamer *Ranger* of the Pittsburgh Coal Co. has been temporarily held up at the plant of the Dravo Contracting Co., Neville Island, Pa. It is expected, however, that the hull will be ready for launching and delivery will be made about May 1.

About one hundred more stainless-steel bullet catchers are being built at The Superior Welding Co., 331 Knoxville, Peoria, Ill. New deck plates are being welded on a soda-pop truck and a large amount of general repair jobs of all kinds are keeping the men at this shop very busy. Many outside jobs are also being taken care of.

The Standard Machine & Auto Works, one of the principal welding service shops in Pasadena, Calif., recently moved from its old stand at 114 W. Union St., to 88-92 N. DeLacy St. E. E. Hawkins and F. L. Raynesford are joint owners in the concern, specializing in heavy welding jobs—both shop and field.

A nice volume of business on a new casing-pulling machine and an oilwell spudder has been built up by the manufacturers, the Hutchinson Foundry & Steel Co., of Hutchinson, Kan. The all-steel construction and welded design, together with other features, have been factors in the increased sales of these articles.

Charles J. Enlind, formerly mechanical engineer for the Western Division plants of the American Bridge Co., has been appointed chief engineer of the Hydrair Corp., 160 N. LaSalle St., Chicago, manufacturers of air-conditioning equipment for industrial plants, office buildings and the larger types of residences.

Earl H. Brown, formerly with the Olson Drilling Co., Burrton, Kan., recently established his own boiler and welding business. "Brownie" has purchased up-to-the-minute welding equipment and is planning on rendering the oilfield operators in the Burrton field some real service.

E. C. Rechtin, who for a number of years has been in charge of welded repair work for the Dravo Contracting Co., of Pittsburgh, Pa., has resigned to accept a position with the Campbell Transportation Co., also of Pittsburgh, as superintendent of construction and maintenance.

The National Electric Welding Corp., of Huntington Park, Calif., has been awarded the contract for the welding of the steelwork of the new White Memorial Hospital, at 312 N. Boyle Ave., Los Angeles. Fully 75% of the steel in this 7-story structure will be electric welded.

The American Body & Welding Co., 919 East 15th St., Kansas City, Mo., has leased the building at 16th and Montgall Aves., where the company will have 15,000 sq. ft. of floor space, a 50% expansion over the old location.

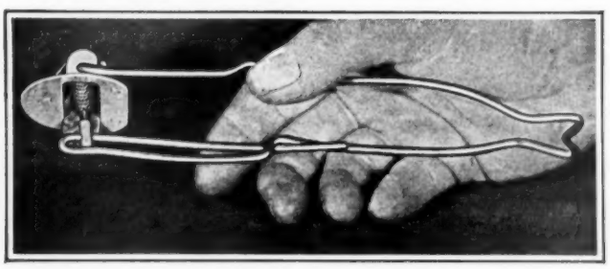
A new steel and sheet-metal building of all-welded construction has been erected by the Williamson Welding Works at its branch shop in Pasadena, Calif., situated at 1126 E. Colorado St. The concern specializes in car-starter and flywheel-teeth welding.

Bids have been received for the butt welding of 26 miles of street-railway track for the Indianapolis Railways, Inc., in Indianapolis, Ind. Thermit welding is specified.

Mac's Welding School was recently organized at 2324 Fourth Ave., Moline, Ill., starting with an enrollment of 20.

The first aviation metalsmith class to be graduated since the school's removal

The Improved "Round File" Gas Lighter



Many superior design and construction features, found only in Improved "Round File," make this lighter the Welder's Favorite.

Hood forms a pocket for gas, insuring immediate ignition.
Larger file area, providing longer life for lighter.
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WE RENT WELDING EQUIPMENT

from Great Lakes, Ill., received their diplomas on Apr. 3, at the Aviation Mechanics School, U. S. Naval Training Station, Norfolk, Va. Hallie P. Davidson is the welding instructor.

Contracts covering the welding of all the steel joists in two school buildings, one at Nashville, Mich., and the other at Olivet, Mich., have been awarded Dillon's Welding Shop, of Battle Creek, Mich. Both jobs will require some 30,000 welds.

The changing over of tractor wheels to permit their use with pneumatic tires, is a line of business developed by James M. Pool, of the Louisville Welding Works, 807 S. First St., Louisville, Ky. A strong demand for tire-equipped wheels is evident on the part of tractor operators.

Welding will be featured largely in the early construction of a dry-ice manufacturing plant to be built in the Imperial Valley, at Niland, Calif. The plant, which is being built by the Natural Dry Ice Corp., of Los Angeles, will cost approximately $37,000.

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EXCESS NEW STOCK—REDUCED APPROX. 30%

2652 ft. rubber-covered super-flexible cable; 196 electrode holders; 127 helmets; 284 hand shields; 361 lenses; 7400 lb. shielded-arc electrodes. Also many used arc welders. Address Ap-4, The Welding Engineer.

For Sale—No. 4 Airco-Davis-Bournonville Oxygraph Cutting Machine, serial No. 410, completely equipped with torches and manifold. Slightly used. Very reasonable. Cash or terms. Vegetable Oil Products Co., Inc., 6100 Avalon Blvd., Los Angeles, Calif.

Arc Welders—3 Una welders (2-operator, can also be used as single-operator), one 2-operator G. E., one 5-operator G. E. All in A-1 condition. Very reasonable. Service Co., 3741 Cedar Ave., Cleveland, Ohio.

Bargains—Demonstrator Arc Welders. Gasoline and electric drive. 30 days' trial. Easy terms if desired. Write Ken's Exchange, Box U-461, Troy, Ohio.

WANTED TO BUY

Metal Spray Gun—Give details and lowest price, also 200-ampere gas-engine arc welder or generator only or electric drive. Address Ap-5, The Welding Engineer.

HELP WANTED

Agents Wanted—For complete line of resistance welding equipment, including spot, seam, flash and butt, portable guns, hydromatic welders, and special welders, special welding fixtures and welding controls. Address: Roth Welding Engineering, 2921 East Grand Boulevard, Detroit, Mich.

Experienced Welding Equipment Salesman—To cover the Northern part of Indiana. Liberal commission with drawing account. Must furnish own car. Give details of experience and references. Address Ap-2, The Welding Engineer.

Salesman Wanted—Experienced in oxyacetylene and arc welding, to solicit business for welding shop. Must be able to weld part time. Academy Welding Works, 516 West 29th St., New York City.

POSITIONS WANTED

Inspector, Supervisor and Instructor of Welding—Specialized 8 years in arc welding. Practical welder. Knowledge of metallography, heat-treating and physical metallurgy. Capable of performing all tests and investigations of weld metal. Has had sales experience. Member of A. W. S. and A. S. M. Knowledge of foreign languages. Consider position outside U. S. A. Available July 1st. Address Ap-3, The Welding Engineer.

Graduate Welding and Mechanical Engineer—With years of practical experience, well acquainted with design, research and supervising work on welding and welded constructions. References available. Address Ap-1, The Welding Engineer.

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Arc Welder—Build your own from Dodge generator. Welding fenders, light castings, etc. Complete blueprints and simple instructions, $1.00. **Paint Striper,** for automobiles or any decorating job. Latest guaranteed tool, $1.00. Agents write. Cash or C. O. D. C. E. Carlson, 2212 Grand Ave., Omaha, Nebr.

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